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ABSTRACT

Information on the expected cropping patterns, livestock enterprises, processing and related activities, income and emplcyment opportunities, capital needs, and training requirements for alternative farm organizational structures that could be selected for development of the Navajo Indian Irrigation Project is presented in this report. The major issues discussed are farm organizational stature, development capital, educational and training requirements, development philosophy, and infrastructure planning. Descriptions of field crop and vegetable crop budgets, livestock production, expected crop and livestock combinations, capital requirements, employment created, training needs, and generation of income are also discussed in terms of the irrigation project. Conclusions in the areas of organizational arrangements, capital requirements, creation of employment and training opportunities, and generation of income are included with related recommendations. Also included are 67 tables and 2 conceptual models of organizational structure for the project. (NQ)

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Alternative Farm Organizational Structures for the Navajo Indian Irrigation Project

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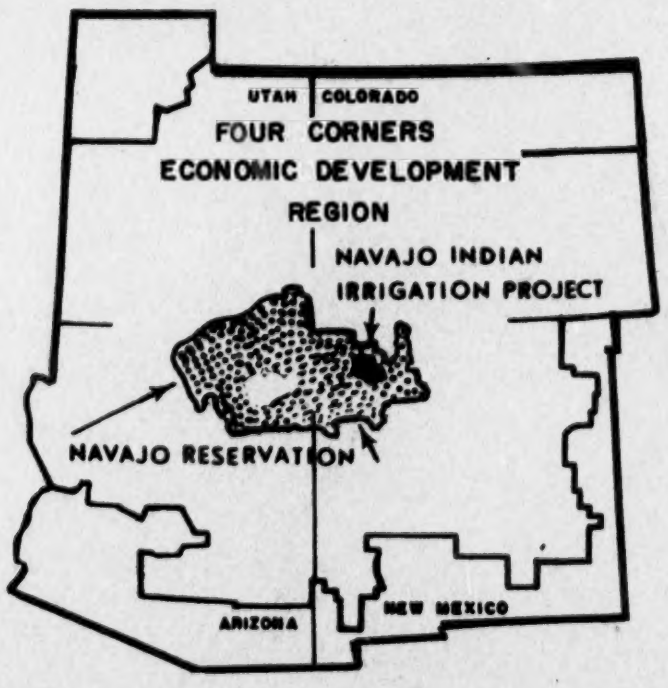

Report to
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PROJECTED CROPPING PATTERNS, LIVESTOCK ENTERPRISES, PROCESSING ACTIVITIES, CAPITAL REQUIREMENTS, EMPLOYMENT, INCOME, AND TRAINING NEEDS FOR ALTERNATIVE FARM ORGANIZATIONAL STRUCTURES FOR THE NAVAJO INDIAN IRRIGATION PROJECT

A Special Report
to the
Four Corners Regional Commission

This report was prepared by members of the Navajo Indian Irrigation Project planning team at New Mexico State University, consisting of William D. Gorman and Robert R. Lansford, Associate Professors, Agricultural Economics; Thomas S. Clevenger, Assistant Professor, Agricultural Economics; Joseph E. Williams, Research Associate, Agricultural Economics; William Trego and Mickey Burkett, Research Aides, Agricultural Economics; E. J. Gregory, Assistant Professor, Agronomy, San Juan Branch Station; Jack M. Jordan, Assistant Professor, Horticulture, San Juan Branch Station; Robert K. Bull and Hector H. Ogaz, Graduate Assistants, Agricultural Economics; Norman Bowman, Soil Conservationist, Bureau of Indian Affairs; and Paul Barnes, Training Specialist, Bureau of Indian Affairs.

Department of Agricultural Economics and Agricultural Business

April 1972 Las Cruces, New Mexico

RC 006131

FOREWORD

Research reported in this publication was supported by Technical Assistance Contract - F.C.R.C. No. 301-300-014 Four Corners Regional Commission, and by the Agricultural Experiment Station, New Mexico State University. The title of the Technical Assistance Contract is "Economic Feasibility of Potential Crops for the Navajo Indian Irrigation Project". This report is the third of a series of three reports resulting from this study.

Representatives from many government and Navajo tribal organizations acted as an advisory committee in guiding the general direction of the study and in gathering much of the specific information. Specific recognition goes to representatives from the following agencies: Four Corners Regional Commission, Resources Committee Navajo Tribal Council, Resources Division of the Navajo Tribe, Bureau of Indian Affairs, Bureau of Reclamation, Soil Conservation Service, Navajo Community College, and the San Juan County Extension Office. Dr. W. P. Stephens, former Assistant Director of the New Mexico State University Agricultural Experiment Station, and Director, New Mexico Department of Agriculture, New Mexico State University, served as administrative adviser to this project.

THIS TECHNICAL ASSISTANCE STUDY was accomplished by professional consultants under contract with the Four Corners Regional Commission. The statements, findings, conclusions, recommendations, and other data in this report are solely those of the contractor and do not necessarily reflect the views of the Four Corners Regional Commission.

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SUMMARY

The Navajo Indian Irrigation Project was authorized by Congress in 1962 with the granting of a water diversion right of 508,000 acre-feet to bring into production 110,630 acres of land in northwestern New Mexico. The first 10,000 acres of land are expected to have water and be ready for farming in 1975.

The primary purpose of the Irrigation Project is to increase employment and income opportunities for the Navajo Nation, which now has an estimated 17,000 to 18,000 unemployed and many more underemployed. The Irrigation Project represents a large investment in developing the reservation's agricultural and water resources and has the potential of providing substantially increased income and employment opportunities.

The objectives of this study were to 1) identify agricultural crops which can be economically produced in the Project area, 2) specify those crops which appear to have the greatest profit potential, 3) determine types of livestock which appear to be economically feasible, 4) specify and evaluate alternative farm organizational structures, 5) determine the amount of investment and operating capital required to adequately develop the Project, and 6) identify the number of personnel and the associated technical skills required to develop and operate the Project.

Two alternative farm organizational structures were considered for developing the Project land: 1) 320-acre individual farms and 2) a tribal enterprise farm. These farm organizational structures were evaluated on a fairly short range--10 years or less; a long-range evaluation might lead to

other conclusions. This is significant for two reasons: 1) young Navajos who normally would be prime candidates to operate individual farms have not had the training or experience to prepare them for this task and 2) many of the crops will be relatively new to the area and people. Thus, it was necessary to make many assumptions in this study. The efficiency and motivation of successful individual farmers were concluded to be the primary advantage of an individual farm development system. The principal disadvantage of individual farms was the lack of trained, experienced commercial Navajo farmers. The potentials for securing financing and experienced management personnel were concluded to be important advantages for a tribal enterprise approach. The primary potential disadvantage was concluded to be the possibility of high administrative and overhead costs.

Several field, fresh market, and processed vegetable crops appeared feasible. Alfalfa, sugar beets, wheat, corn, fresh market carrots and potatoes, and processed asparagus and snap beans were among the crops showing the greatest potential.

Backgrounding feedlots of 100-head capacity were found to be a feasible livestock activity on the individual farms. Cattle feeding, dairy, hogs, and layers were found to be feasible livestock and poultry alternatives for a tribal enterprise farm. Some of these livestock alternatives could be feasible for individual farm development through cooperatives or tribal-owned enterprises serving the individual farms.

Optimum crop and livestock combinations, investment and operating capital requirements, employment created, training needs, and income potential were determined for development on the basis of individual farms and a tribal enterprise farm.

Linear programming was utilized to determine the crop and livestock combinations which maximized net returns to capital and management for individually operated 320-acre farms and net operating profit for the tribal enterprise farm subject to specific assumptions and constraints. These crop combinations were then used to predict capital, employment, and income.

The integrated tribal enterprise farm approach was found to require $56.5 million for investment capital and $43.6 million for operating capital. This compared with $50.4 million and $32.3 million, respectively, for the individual farm approach. However, the enterprise farm approach created 224 more employment opportunities during the low labor season. Approximately 2,400 jobs were created during the peak seasonal employment period. The number of jobs created were similar for both organizational approaches. The tribal enterprise farm generated $9.186 million in annual labor income compared with $6.315 million for the individual farm approach upon complete development of the Project.

The fully developed enterprise farm was predicted to generate, by the end of the twelfth development period, a cumulative total of $40.9 million more expendable net income after interest and principal payments. This was approximately $35 million more than development on the basis of individual farms.

It was concluded that it should be easier for the Tribe to obtain the necessary capital for the enterprise farm development approach than for individually operated farms. Higher profitability of the enterprise farm

and lower risk of loaning capital to the Tribe than to individuals are two of the more important reasons.

It was concluded that it would be advantageous to develop the Project on the basis of a tribal enterprise farm. However, after a cadre of experienced Navajo farmers becomes available, a combination of individual farms and tribal enterprise activities could be a workable organizational alternative.

INTRODUCTION

The purpose of this report is to present information on the expected cropping patterns, livestock enterprises, processing and related activities, income and employment opportunities, capital needs, and training requirements for alternative farm organizational structures that could be selected for the development of the Navajo Indian Irrigation Project.

The Navajo Indian Irrigation Project is a 110,630-acre irrigation development for the Navajo Indians. The land to be irrigated is located south of Farmington, New Mexico. The Project has a diversion allocation of 508,000 acre-feet from the San Juan River.

The United States Congress has authorized $206 million for construction of the Irrigation Project including purchase of irrigable lands not presently within the reservation (11). Approximately $47 million has been appropriated for project construction through fiscal year 1972. The Project is funded through the Bureau of Indian Affairs, and construction is a function of the Bureau of Reclamation. The completed project will be held in trust by the U. S. Department of Interior for the Navajo Tribe. Trust lands cannot be sold or mortgaged by the Tribe or individual Navajos. There will not be any private ownership of irrigated lands, either Navajo or non-Navajo.

Construction of the conveyance system began on a limited basis in 1964. The first water is expected to be available for approximately 10,000 acres of Project land by 1975. The development schedule calls for water to be delivered to approximately 10,000 acres each following year until the entire Project is developed.

The primary purpose of the Irrigation Project is to increase employment and income opportunities for the Navajo Nation. It is estimated that 17,000 to 18,000 Navajos are presently unemployed. The Irrigation Project represents a large investment in developing a renewable resource which has the potential of providing a base for substantially increased income and employment opportunities if properly developed.

The specific objectives of this study are to 1) identify and describe the economic potential of agricultural crops which can be grown in the Navajo Project area, 2) specify those crops which appear to have the greatest profit potential given the resources available and the competitive situation of the project area, 3) determine types of livestock which will be economically feasible in the area and will assist in the overall development of the project by providing markets for grain and roughage crops and additional employment opportunities, 4) specify and evaluate alternative farm organizational structures, 5) determine the amount of investment and operating capital required to adequately develop the project, and 6) identify the number of personnel and associated technical skills required to develop and operate the project successfully.

Major Issues

There are several major issues pertaining to the project development that will have to be resolved. Most of these issues involve policy decisions by the Navajo Indian Tribal Council. It is hoped that this report will provide much of the information needed as a basis for these critical decisions.

Farm organizational structure. One of the big issues is whether the land should be divided into individual entrepreneurship farms, possibly ranging from 320 acres to as much as 1280 acres, or should be organized as a tribal enterprise farm, or farms, ranging in size from 10,000 acres to one large 110,630-acre farm. Another alternative would be a combination of tribal enterprises and individual entrepreneurship-size farms (9).

Development capital. The authorized $206 million provides funding to deliver water to the project lands. It does not provide capital for sprinkler irrigation systems, land development, farm equipment and buildings, operating and maintenance expenses. Sources for this substantial capital requirement is another important issue.

Education and training requirements. Another major issue is the educational and training requirements to make the project a success. The project is very large and will need educated and well-trained Navajo personnel to insure success.

Development philosophy. What development philosophy should the Navajo Tribe follow? Should the Tribe attempt to plan the development for the greatest benefit to a maximum number of tribal members, or should the benefits primarily accrue to a relatively few selected, highly-trained individuals?

Infrastructure planning. The scale and scope of infrastructure to be developed on the project lands is an issue of major consideration. Should there be a whole new town built around the project lands, or should it be considered another industrial development in the San Juan Basin with

the infrastructure developed in conjunction with the present towns existing in the area.

Decisions on all these major issues revolve around the organizational structure selected for developing and farming the project. This report is built around recognition of this fact. The organizational structure selected has a substantial impact upon each of the major issues. An attempt was made to evaluate the impact of the organizational structure on 1) capital needs and sources, 2) employment opportunities and total employment created, 3) income potential, 4) training needs, and 5) infrastructure considerations. However, since infrastructure planning was not one of the objectives of this study, evaluation of alternative approaches to developing the infrastructure was, by necessity, limited. Infrastructure planning could not be totally ignored, since one of the primary objectives was to estimate the approximate capital requirements for development of the total project.

ALTERNATIVE ORGANIZATIONAL STRUCTURES

Two basic alternative farm organizational structures for farming the project land are presented in this report. They are an enterprise farm and individual entrepreneurship farms. The enterprise farm would operate with a board of directors appointed by the Navajo Tribe. The board of directors would hire expert management to coordinate and direct activities on a day-to-day basis. Individual entrepreneurship farms would be 320 acres or larger and would function as separate decision units similar to many family farms throughout the United States. The project could also be developed utilizing a combination of tribal enterprise and individual entrepreneurship farms.

The type of organizational structure selected for farming operations will have considerable impact on the total organization and development of the Irrigation Project. Many activities that would be an integral part of the tribal enterprise farm such as processing, marketing, and purchasing will be provided by off-farm organizations if the Project is developed as individual farms. These activities could be solved by farmer-owned cooperatives. These processing, marketing, and purchasing activities as well as some custom harvesting are important to either organizational structure if the Irrigation Project is to attain reasonable levels of efficiency and to realize its goal of creating substantial employment. Figures 1 and 2 present possible organizational structure of the Irrigation Project under a tribal enterprise farm and an individual farm development, respectively.

A possible organizational structure for a tribal enterprise farm is illustrated in figure 1. The Tribe may wish to coordinate all Irrigation Project activities through the Navajo Agricultural Products Industry Board. This board would hire a general manager who, along with his subordinates, would be the chief operating officers. All the necessary business and service activities to make this project a success would be operating units reporting to and controlled by the general management office. The principal departments anticipated are farm supply, marketing and transportation, processing and livestock industries, farming, irrigation, and infrastructure.

The farm supply department would be charged with the responsibility for purchasing major inputs needed for the farming and processing activities. Important activities would include determining machinery needs, arranging for purchase, and maintaining a supply of necessary spare parts.

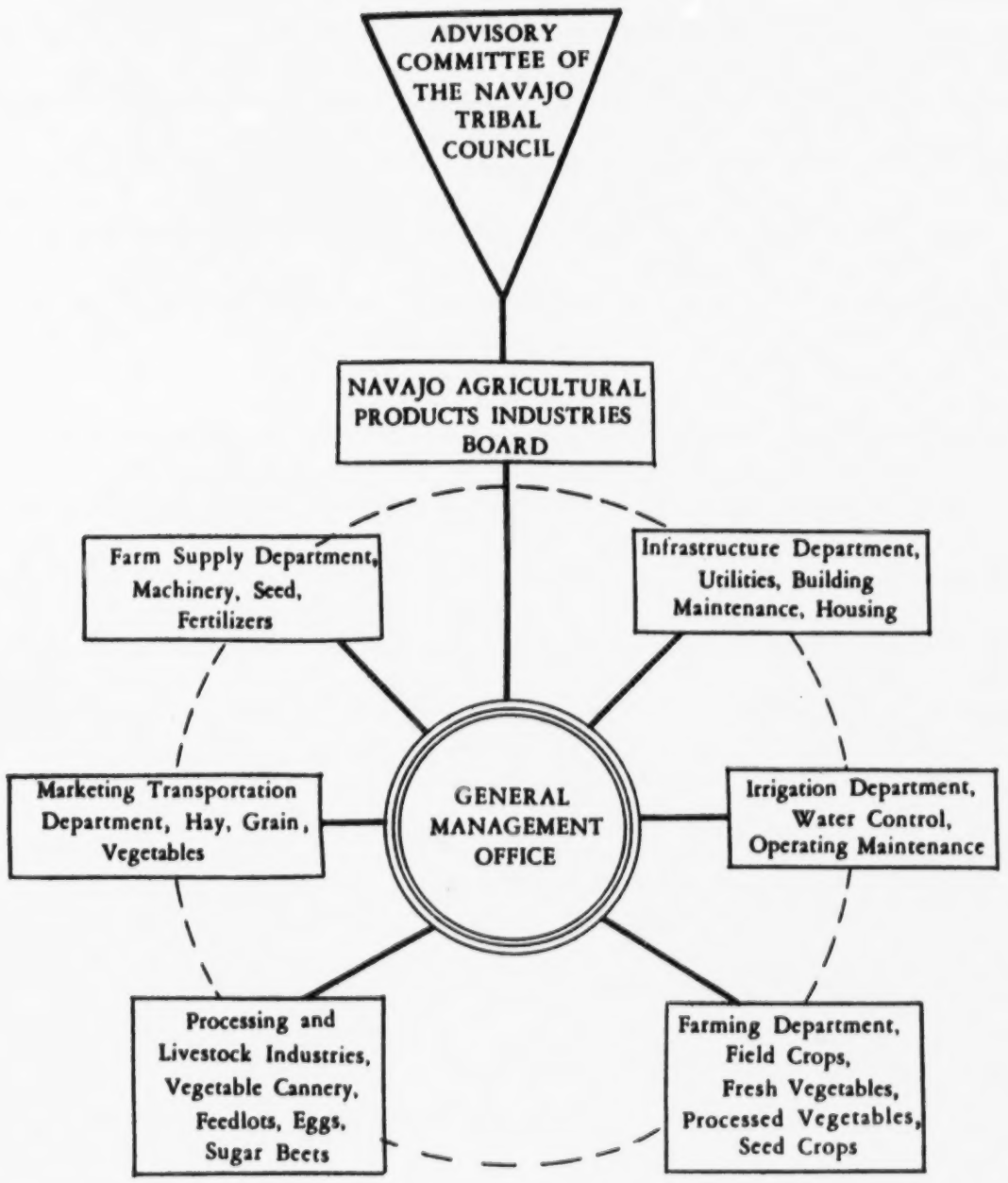
ADVISORY COMMITTEE OF THE NAVAJO TRIBAL COUNCIL
NAVAJO AGRICULTURAL PRODUCTS INDUSTRIES BOARD
Farm Supply Department, Machinery, Seed, Fertilizers
Infrastructure Department, Utilities, Building Maintenance, Housing
Marketing Transportation Department, Hay, Grain, Vegetables
GENERAL MANAGEMENT OFFICE
Irrigation Department, Water Control, Operating Maintenance
Processing and Livestock Industries, Vegetable Cannery, Feedlots, Eggs, Sugar Beets
Farming Department, Field Crops, Fresh Vegetables, Processed Vegetables, Seed Crops

Figure 1. An example of a possible organizational arrangement for the Navajo Indian Irrigation Project developed under a tribal enterprise farm approach

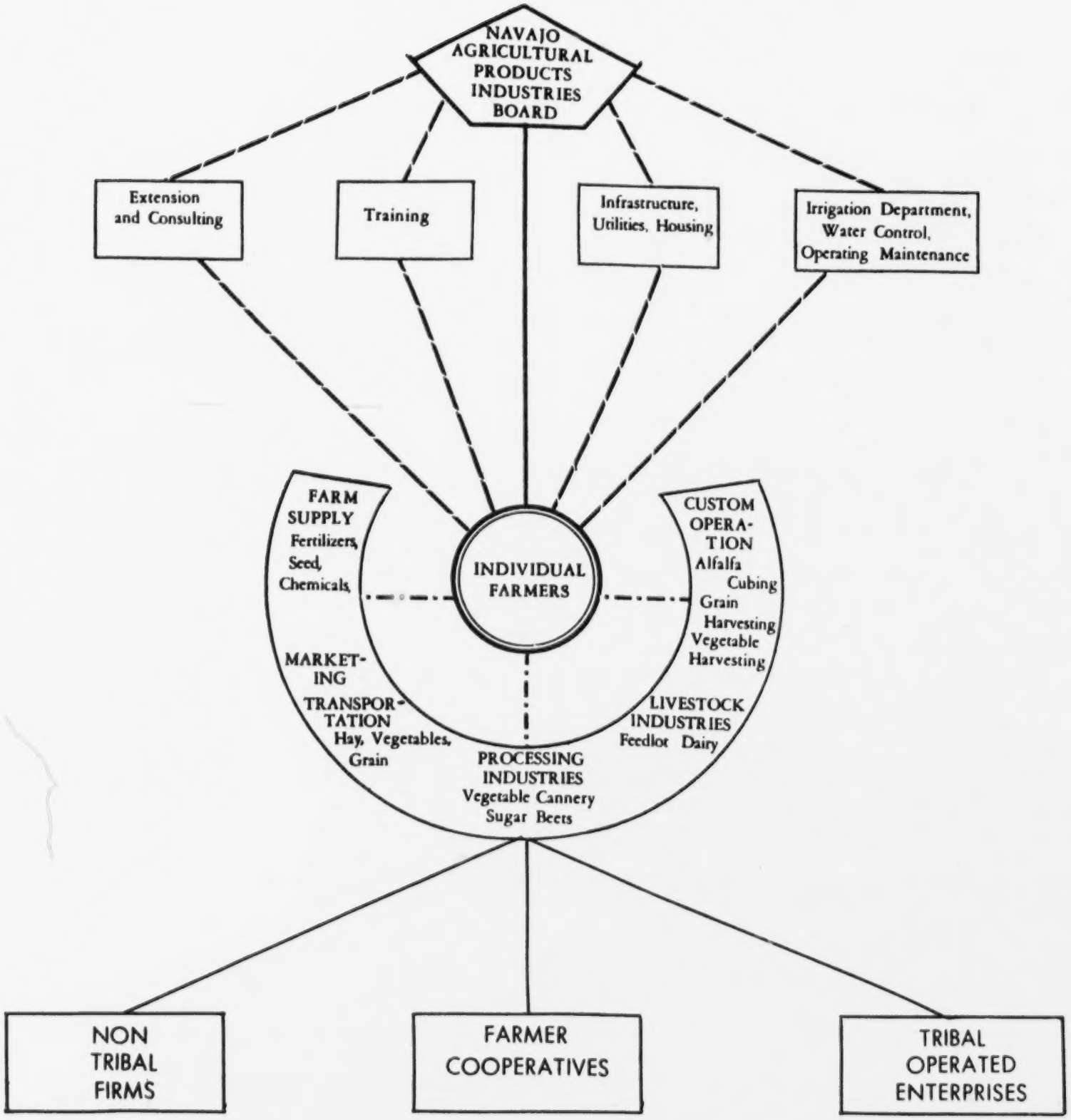

Figure 2. An example of a possible organizational arrangement for the Navajo Indian Irrigation Project developed under individually operated farms

The marketing and transportation department would coordinate marketing activities for all products produced. This department would not only select appropriate market outlets, but also coordinate transportation of the commodities.

The processing and livestock industries department would vary in scope depending upon the number of activities involved. Under present conditions, vegetable canning, dairy, egg production, feedlots, swine, and sugar beet processing appear promising. These activities would be coordinated by this department.

The farming department would be charged with the major responsibility of producing the crops. The decisions as to how and when to plant, irrigate, and harvest would be made by this department.

The irrigation department would be in charge of the water delivery system. They would coordinate the water needs as well as arrange for operating and maintaining the system.

The infrastructure department would have responsibility including utilities arrangement and coordination, building construction and maintenance.

The important factor to stress under a tribal enterprise farm development approach is that all decisions for the project would be coordinated through one general management office. Decisions on crops and livestock to produce would be made by the general management office taking into consideration production costs, marketing, and processing opportunities.

A possible organizational structure for the Navajo Irrigation Project under individual farms is presented in figure 2. Most activities in service, supply, and processing industries could be identical under both development approaches. The basic difference between individual farm development and

tribal enterprise development would be in the number of decision units. Individual farmers would each make independent decisions on what crops to produce, where to obtain farm supplies, and time and method of marketing their products.

Under individual farm development the Tribe would also have an agricutural products board. This board would coordinate general activities of the Irrigation Project, including allocating land assignments and collecting lease payments. There would also be a need for extension and consulting services as well as on-farm and classroom training programs to work with the individual farmers. Too, there would be a need for an organization that would coordinate the infrastructure items, particularly utilities, roads, and housing. The irrigation department would be similar to and have the same functions as an irrigation department under the tribal enterprise farm development.

The primary difference between the organizational structures would be in coordinating the activities of farm supply, marketing, processing, livestock industries, and custom harvest operations. There are at least three alternatives that would be available for this coordination. The Tribe could organize and operate service, processing, and marketing industries. There would also be substantial opportunity for non-tribal operated firms to provide these services. These firms could either be operated by Navajos or non-Navajos. A third alternative would be for individual farmers to form cooperatives to purchase supplies or engage in processing and marketing activities on their behalf. Each of these alternatives have a set of advantages, as well as disadvantages, but all appear feasible.

Tribal Enterprise Farm

The tribal enterprise farm development and operation of the 110,630-acre Navajo Indian Irrigation Project was initially suggested because of the successful operation of two other Navajo enterprises--Navajo Forest Products Industry and Navajo Tribal Utility Authority. The tribal enterprise farm could consist of one 110,630-acre farm or several smaller management units. However, the minimum economic size of a unit for farming operations that employ management who perform no labor function appears to be approximately 6,000 acres. Most of the economies of size resulting from volume purchasing and marketing, as well as efficient use of some specialized machinery, requires about 6,000-acre farms planting a combination of crops that would likely be grown on the Irrigation Project.

Advantages

Management. A principal advantage of tribal enterprise farm development of the Irrigation Project would be the ease of hiring expert management for all key positions instead of initially training the individual Navajo in all aspects of management required to operate a commercial family farm.

Labor specialization. Large organizations can provide the opportunity for employees to specialize in specific areas. For example, individuals can specialize as equipment operators, irrigators, marketing specialists, animal specialists, or entomologists. Labor specialization will make the training process easier. It is much easier to train individuals in specific technical or mechanical skills than to train them for a broad spectrum of activities.

Production-marketing coordination. Large farming operations have a better opportunity to coordinate their production with the needs and requirements of markets and processing plants. This is particularly important for fresh market and processed vegetable crops. Large-scale farming units have a great incentive to expand into related or integrated business activities such as processing plants, packing sheds, farm supply, and marketing firms. An integrated production, processing, and marketing organization is generally more efficient from a total food industry standpoint. A fully integrated operation eliminates the need for and the cost of establishing prices between production, processing, and marketing.

Machinery efficiency. Much of the machinery and equipment available requires a sizable acreage to be used efficiently. This is particularly true of harvesting, tillage, and planting equipment. Large production units have a greater opportunity for efficient machinery use than do most small farms.

Purchasing. There are considerable economies to be gained in purchasing farm inputs on a volume basis. These include fuel, fertilizers, insecticides and pesticides, and farm machinery and equipment. Firms purchasing farm inputs for many thousands of acres can obtain substantial discounts.

Capital. Project development will require a substantial amount of capital. Neither the Navajo Tribe, nor individual Navajos, have sufficient financial resources which can be devoted to project development. Very few Navajos have sufficient financial resources for collateral to enable them to borrow long-term or short-term funds from conventional sources.

Individual Navajos would not own the land, hence it could not be used for collateral. Traditional lending sources are also hesitant in loaning to individuals with limited experience in operating irrigated crop farms. Because of the large amount of capital needed and the expected difficulties of obtaining funds from traditional lending sources, the majority of development funds will probably have to come from the federal government.

The federal government, as well as traditional lending sources, will probably be more willing to loan sizable quantities of funds to the Tribe than to individuals. Once a tribal enterprise farm has demonstrated that it can operate profitably, traditional lending sources may be willing to participate. The tribal enterprise farm would have the opportunity of using the securities market as a source of long-term debt funds. This source is not practical for small individual farms unless handled through and guaranteed by the Tribe.

Adjustments in size of farm. Many technological developments in the past have resulted in the need to increase acreage in order to have an efficient farming unit. Development of large farm implements which obtain efficiency only with large acreages is a noteworthy example. It is reasonable to expect that future developments will continue to result in the need for adjustments in individual farm sizes to maintain efficient units. Large farming operations do not have to be concerned with consolidating units, which is an inherent problem among family farms. Family-type farms generally have a home associated with a given tract of land. Changes in farm size involve adjustments in living patterns as well as in the farm business. Large farming operations, cultivating several thousand acres, have the flexibility of utilizing technological

changes without adjusting farm size, since the size of the farm unit is not determined by any particular technology such as size of harvesting equipment or tractors.

Infrastructure needs. The infrastructure requirements for a tribal enterprise farm would be substantially different and less complex than an individual farm development approach. The tribal enterprise farm can be considered as an agribusiness, and there would be no need to associate living on the land with working the land. An enterprise farm could have one large headquarters with possibly several sub-base units located on the project lands. Only limited housing would be required on the project lands, and it could be located in one area, eliminating the need for a costly utility network on the project.

Profits. Operation of the Irrigation Project as a tribal enterprise farm would enable the Tribe to establish a profit-seeking organization which would pay competitive wages and create substantial employment. Profits resulting from this operation would accrue to the Tribe through its ownership of the agricultural enterprise. These profits could then be used by the Tribe for development and social programs.

Disadvantages

Management. Management of large agricultural farming enterprises is difficult. The operation's effectiveness depends upon the managerial ability and skill of a few key individuals. Large farming enterprises, like most large businesses, have difficulty in motivating individuals to work at their most efficient levels. Individuals usually perform best

when they receive compensation based on their performance. Large enterprises have difficulty in designing compensation programs based on performance because of the difficulty of measuring an individual's performance.

Communication. A large tribal enterprise farm would have many employees. Efficient performance requires good communication between employees and management. Coordination of activities between managers of interdependent departments is also essential and required for good communications. However, effective communication is difficult to achieve, particularly as the size of organization increases. Individually operated farms experience few internal communication problems since the manager and laborer are embodied in one person.

Costly overhead. Large-scale organizations have substantially more overhead than small farms. Coordination and communication among many individuals and activities require several layers of management and supervisory personnel which are not required on small farms.

Labor inflexibility. Large-scale organizations are not as flexible in the use of labor as small organizations or individually operated farms. Large organizations must have stated operating policies and procedures governing use of labor to operate effectively.

Individual Farms

Individual farms may be described as family farms. The farms could range in size from 320 to over 1,000 acres. Farm size would depend upon many factors, including sufficient land to support a family, amount of capital available,

acreage of crops required to yield an economic return, and policy decisions by the Navajo Tribe. A 320-acre farm appears to be about a minimum-sized economic unit for crops likely to be grown on project lands. Approximately 320 acres would be required to provide sufficient labor income to support a family, to pay a competitive interest rate for capital, and to repay borrowed capital.

If the entire 110,630 acres were divided into 320-acre farms, there would be 345 farms. If 640 acres or 1280 acres were selected as the typical farm size, there would be 173 and 86 farms, respectively. For evaluation purposes, budgets were developed for 320-acre, 640-acre, and 1280-acre farms. However, much of the detailed analysis was based on 320-acre farms as an example of income, employment, infrastructure, and training needs under individual farm ownership.

Advantages

Management. Good entrepreneurs are highly efficient producers of agricultural products. Since their compensation is based upon their managerial ability and willingness to work, they are generally motivated to be efficient.

Flexibility in income and labor. Individual-size farms depend upon the operator for most of the labor and are more flexible than large operations. Owner-operators are more willing than paid salary workers to work extremely long hours during peak work seasons, and can adjust to receiving less compensation for their labor during poor years. This is important in farming which is subject to sizable peak labor needs, substantial price and weather fluctuations which cause variation in incomes from year to year.

Lower administrative cost. Since the decision-maker and labor are, for most tasks, embodied in the same individual,there is very little cost involved in communicating decisions from management to employees and in supervision. The lower cost associated with communicating decisions and supervision decreases overhead cost.

Disadvantages

Training managers. It is difficult to identify and train potential managers without simultaneous on-the-farm experience. Individuals can be trained in technical skills, but imparting the essence of entrepreneurship and ability to make financial decisions is very difficult. Individuals must be in a position to make decisions while learning. Very few Navajos are presently trained or have experience in operating commercial irrigated farms.

Capital. Very few Navajos have sufficient capital resources to finance a commercial size farm. Individual Navajos would not have title to the land, and so, could not mortgage the land to obtain operating and investment capital. Financing for individual Navajos will probably be through the Tribe because of their limited equity position and farming experience.

Income and employment opportunities. Individual Navajo farmers would be expected to make cropping and livestock decisions on the basis of available financing, family labor, special interests, and expected net income from farming. The Tribe would probably have to undertake processing and livestock industries for the full income and employment potential to be realized.

Production, processing, marketing coordination. Coordinating production with processing and marketing activities is more difficult with individually

operated farms than with a tribal enterprise farm. These decisions would be spread among many individually operated farms. Processing and marketing contracts specifying pricing procedures and quantities produced are the coordinating techniques used most frequently. Voluntary compliance would be difficult to achieve.

Equity. To be successful, an individual farmer must be rewarded on the basis of his efforts. A farm operator must receive benefits from his work,or he will lose interest and tend to do poorly. Therefore, successful total project development requires a substantial amount of the reward to accrue to individual farmers. This would be 345 Navajo farmers, or less, depending upon the size of farms. This small group of farmers would profit substantially more from the Irrigation Project than most other individuals in the Tribe.

Land assignment. The Navajo Tribe has never revoked a land assignment given to an individual because of lack of production. It is reasonable to expect, on the basis of past experience, that a substantial number of individuals would not succeed at farming. Hence, there would be the need to revoke land assignments in order that the project could be fully developed and operated at its maximum potential. Based upon past tribal policies, this could prove difficult.

Selection process. It will be difficult to determine who gets a farm. It will also be difficult to determine who gets what farm, since all farms would not be equal in value because of differences in location and soil. There would need to be a substantial effort in establishing selection

criteria and a system for the actual selection process. This process would be difficult and could result in serious political problems for the Tribe.

Infrastructure. Individual family settlement would require substantially greater investment in selected infrastructure items than would the enterprise farm. It is reasonable to assume that if individuals were given 320 acres or larger assignments, they would need to establish a home on the property for security purposes and control of livestock activities. This type of settlement would require substantial investment in water, sewer, telephone, electricity, and gas facilities. It would also require a larger investment in all-weather roads.

Tribal Action to Date

The Navajo Tribe has taken several steps toward development of the first 10,000 acres under an enterprise farm approach. They have organized a Navajo Agricultural Products Industry patterned after the Forest Products Industry and the Navajo Tribal Utility Authority. The Navajo Agricultural Products Industry has been approved by the Tribal Council. A board of directors composed of 13 members has been appointed. Seven members are progressive Navajos, and six are leading agricultural and non-agricultural businessmen throughout the United States. The Chairman and Vice-Chairman of the Navajo Tribe are members of the board. This board has been granted authority by the Tribe to coordinate all agricultural activities.

The Navajo Tribe is presently farming 700 irrigated acres in the Shiprock area as a tribal enterprise farm. They are doing this with assistance from the Bureau of Indian Affairs and Four Corners Regional Commission. It is anticipated

that this farm,with additional land from the Hogback Project,will be expanded to 2,378 acres during the spring of 1972. It is also anticipated that a 5,000-head feedlot will be constructed and in operation by the fall of 1973. This farm is operated through a manager employed by the Navajo Agricultural Products Industry. One major purpose of this farm is to provide Navajos with experience in farming and related agricultural industries. Furthermore, it would serve as a basic organizational structure for effectively developing the Navajo Indian Irrigation Project lands.

In considering the historical perspective, most land settlement programs for Indians have not been successful in providing a satisfactory livelihood for families from farming. The Fruitland Project involved settlement of families on 10 and 20 acres of land. The acreage was insufficient for an economic unit, and that project is not a significant commercial agricultural development. Many of the assignments have become merely places of residence with little or no active farming.[1]

A portion of the Hogback Project involved settlement of 11 Navajo families on farms ranging from 105 to 140 acres. The families were financed from the Tribe's Revolving Credit Fund,with loans ranging from $18,000 to $38,000 each. The Navajo Tribe received partial payment on these loans, and the unpaid balance was written off the book, except for the farms still in operation.

In the mid-1950's, 149 Navajo families were transferred to individual farms on the Colorado River Indian Reservation. Only 53 families have

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1 The Navajo Agency, The Navajo Yearbook, Report No. viii, 1951-1961 A Decade of Progress, Compiled with Articles by Robert W. Young, Window Rock, Arizona, 1961.

remained. None are actively engaged in farming at the present time. Many lease their land to non-Indian farmers.

The experiences gained by these three irrigation projects for Navajo Indians, as well as others, indicate the need for careful, thorough planning and analysis of organizational structure, training programs, and financing sources and methods. The Project is very large, and a sizable investment is involved. Lack of success with the first units could adversely affect funding for units to be developed later.

SUMMARY OF CROP AND LIVESTOCK BUDGET INFORMATION

To determine the most profitable commodities to produce on the Navajo Indian Irrigation Project, it was necessary to evaluate all agricultural crops and livestock which were thought to have potential. Many of these were eliminated from further consideration for agronomic, climatic, and marketing reasons, on the basis of opinions by experts (Appendix A). Commodities found to be agronomically and economically suitable for the Navajo Indian Irrigation Project included 11 field crops, 11 vegetable crops, 1 orchard crop, and 7 livestock activities. The crops and livestock commodities were selected by the Navajo Indian Irrigation Project research team at New Mexico State University and by an advisory committee composed of individuals from the Bureau of Reclamation, Bureau of Indian Affairs, Navajo Nation, Navajo Community College, San Juan County Extension Service, and the Soil Conservation Service.

Survey of Market Potential

Commodities which could be produced on the project lands were screened with respect to their market potential. This screening included a consideration of 1) the quality and related marketability of commodities which could be produced, 2) the way the commodity would fit into the United States seasonal flow of this product to market, 3) price changes induced as a result of increased production, 4) federal supply-restraint programs, 5) the transportation situation, and 6) net return compared to alternative commodities. These market potential factors were considered primarily from the viewpoint of the total development of the Navajo Indian Irrigation Project.

For each commodity, the nature of the market and the product form were considered. For example, the nature of the market for corn silage is local, because of bulk and low value per ton; but, the market for canned vegetables produced at any one location is more nationwide.

The United States seasonal marketing patterns for commodities were examined to determine whether commodities produced on the project lands could fit into slack periods in volume marketed. Geographic location and comparative position of competing producing areas were considered. Location of markets for commodities and their respective transportation costs were also considered.

Comments and opinions of food and fresh vegetables brokers and shippers were used to verify the likelihood of being able to market the anticipated volume of commodities in designated markets at specified prices. These comments were used to define the prime market areas for products produced on the project lands. Transportation of products to markets was assumed to

be by carriers not affiliated with the Project. The opportunity for a tribal transportation business should, however, be given consideration.

Crop Budget Information

Information on crop inputs, production costs, yield and dollar returns is summarized in this section. A listing of crops for which information was developed is presented in table 1. Crop budgets were developed for 320-, 640-, and 1280-acre, individually operated farms and for tribal enterprise farms exceeding 6,000 acres. Detailed budget information for the crops listed in table 1 for the various farm sizes is reported in New Mexico Agricultural Experiment Station Research Reports 194 (5) and 199 (6).

Materials and services. The quantities and kinds of fertilizers, seeds, chemicals, assessment fees for irrigation, and other purchased items required for an acre of each crop were obtained from farm supply stores, catalogs, and information published by agricultural experiment stations. Prices did not include application, because these costs are included in machinery and labor costs. A 20-percent discount from typical retail prices for the tribal enterprise farm was assumed and attributed to cooperative purchasing of supplies in large quantities.

Machinery Costs

Machinery inventories were prepared separately for each of the four farm sizes studied (320-, 640-, 1280-acres, and the tribal enterprise farm) because equipment combinations and accomplishment rates used in preparing the crop budgets varied between farm sizes. Equipment inventory selections, prices, hours of annual use, fixed and variable expenses per hour, and total cost per

Table 1. Crops (with planting and harvesting dates), found most likely, on the basis of production and marketing opportunities, Navajo Indian Irrigation Project

Crop	Planting Date(s)	Harvesting Date(s)
FIELD CROPS		
Sugar beets	Mar. 30 - May 15	Oct. 15 - Dec. 1
Alfalfa hay	Aug. 15 - Sept. 15	May 15 - Sept. 30
Dry beans	May 15 - June 30	Aug. 25 - Oct. 15
Soybeans	May 1 - 20	Oct. 1 - 30
Grain sorghum	May 15 - 30	Oct. 15 - Dec. 15
Corn grain	May 1 - 20	Oct. 15 - Dec. 1
Corn silage	May 1 - 20	Aug. 20 - Sept. 10
Winter barley	Sept. 1 - 20	June 20 - July 10
Winter wheat	Sept. 1 - 20	July 1 - 15
Irrigated pasture	Aug. 15 - Sept. 15	
SEED CROPS		
Alfalfa for seed	Aug. 15 - Sept. 15	Aug. 1 - Sept. 15
VEGETABLE AND FRUIT CROPS		
Asparagus (processed)	June 1	Apr. 15 - June 15
Beets (processed)	Apr. 1 - July 1	July 15 - frost
Bell peppers	May 1	Aug. 1 - frost
Cabbage (processed)	Mar. 15 - Apr. 1	Aug. 1 - Oct. 1
Carrots (fresh)	Apr. 1	July 15 - Nov. 1
Carrots (processed)	Apr. 1	July 15 - Nov. 1
Cucumbers (processed)	May 15 - July 15	July 15 - Sept. 15
Onions	Apr. 1	Sept. 15
Potatoes (fresh)	Apr. 1	Aug. 15
Snap beans	May 1	July 1 - Oct. 5
Sweet potatoes	May 1 - 15	Sept. 20 - Oct. 10
Apples	Early spring	Late summer - fall

hour for the 320-, 640-, and 1280-acre farms are reported in the New Mexico Agricultural Experiment Station Research Report 194 and for the tribal enterprise farm in Research Report 199. This information is also summarized for the four farm sizes in tables 2, 3, 4, and 5. Custom harvest rates were used in preparing budgets for the 320-, 640-, and 1280-acre farms in situations where custom harvesting was cheaper than owning the machinery. These custom rates are reported in New Mexico Agricultural Experiment Station Research Report 194.

Information on sizes of equipment required for the different farm sizes was taken partially from a study of the Pecos Valley's machinery requirements by farm size (7), from an Arizona study on machinery requirements by farm sizes (8), and from the experience of individuals within the New Mexico State University Agricultural Experiment Station. New machinery prices for 1970 were obtained from the Tractor Blue Book and from local dealers' price lists. Performance ratings and estimated costs of owning and operating farm machinery were taken from Arizona and California publications (4 ,10). Accomplishment rates (hours per acre required for machine operation) for predominantly sandy soils were derived from the Arizona study. The hours of annual use were determined by linear programming on the computer after a preliminary selection of crops for the different farm sizes had been made and after the acreage for each crop was determined. Adjustments were made in the operating costs of the required machinery to be realistic with the time each machine would be required for the different crops. Machinery operating costs include fuel, repairs, depreciation, insurance, and shelter. They do not include interest on investment nor taxes.

Table 2. Investments in machinery, equipment, and facilities for a typical 320-acre farm, Navajo Indian Irrigation Project

Equipment	Size	New Price
		dollars
SELF-PROPELLED		
Tractor[1]	30 H.P.	6,200
Tractor[1]	40 H.P.	7,400
Swather	12'	5,200
Total		18,800
IMPLEMENTS		
Baler (PTO)	2 wire	3,000
Corn planter	4 row	1,500
Cultipacker	8'	550
Cultivator	4 row	930
Sidedress attachment	4 row	370
Disc	12'	1,100
Drill with fertilizer attachment	12'	1,000
Fertilizer spreader	12'	600
Harrow	16'	500
Land plane	8 x 30'	1,000
Lister	4 row	850
Plow, moldboard	3 14"	1,100
Rotary hoe	4 row	625
Shredder	2 row	600
Sprayer, tractor mounted	4 row	700
Transplanter	2 row	660
Vegetable planter	4 row	820
Total		15,905
BACKGROUNDING FEEDLOT	200 head	6,360
SPRINKLER IRRIGATION SYSTEM		32,000

1 Horsepower ratings for tractors are based on 75 percent of drawbar rating.

Table 3. Investments in machinery, equipment, and facilities for a typical 640-acre farm, Navajo Indian Irrigation Project

Equipment	Size	New Price
		dollars
SELF-PROPELLED		
Tractor[1]	30 H.P.	6,200
Tractor[1]	40 H.P.	7,400
Tractor[1]	70 H.P.	8,300
Swather	14'	5,500
Total		27,400
IMPLEMENTS		
Baler (PTO)	heavy duty	3,700
Corn planter	4 row	1,500
Cultipacker	12'	660
Cultivator	4 row	930
Sidedress attachment	4 row	370
Disc	14'	1,320
Drill, fertilizer attachment	14'	1,350
Fertilizer spreader	12'	600
Harrow	24'	700
Land plane	10 x 40'	2,900
Lister	4 row	850
Plow, moldboard	4 16"	1,500
Rotary hoe	4 row	625
Shredder	4 row	1,350
Sprayer, tractor mounted	6 row	800
Transplanter	2 row	660
Vegetable planter	4 row	820
Total		20,635
BACKGROUNDING FEEDLOT[2]	500 head	27,390
SPRINKLER IRRIGATION SYSTEM		64,000

1 Horsepower ratings for tractors are based on 75 percent of drawbar rating.

2 Forty percent of the 640-acre farms would have a 500-head capacity backgrounding feedlot.

Table 4. Investments in machinery, equipment, and facilities for a typical 1280-acre farm, Navajo Indian Irrigation Project[1]

Equipment	Size	New Price
		dollars
SELF-PROPELLED		
Tractor[2]	40 H.P.	8,400
Tractor[2]	70 H.P.	10,000
Tractor[2]	90 H.P.	12,700
Combines		
Corn	4 row	14,500
Grain	18'	13,600
Edible bean	16'	13,300
Cucumber harvester	7'	26,000
Forklift		6,000
Hay cuber		36,000
Snap bean harvester	2 row	20,000
Sprayer	12 row	5,700
Swather	16'	5,700
Trucks	18' tandem	6,600
Pickup		2,700
IMPLEMENTS		
Baler (PTO)	Heavy duty	3,700
Beet harvester		8,600
Bin trailers		1,200
Blade	6'	500
Cabbage harvester		10,500
Carrot harvester		6,000
Chisel applicator	16'	1,800
Corn planter	6 row	2,950
Cultipacker	16'	900
Cultivator	6 row	1,200
Sidedress attachment	6 row	500
Disc	21'	1,940
Disc border		380
Drill, squadron	2 14'	3,200
Electronic thinner	6 row	9,500
Fertilizer spreader	12'	600
Flail shredder	7'	975
Harrow	36'	750
Land plane	12 x 40'	3,000
Lister	6 row	1,100
Onion lifter	4 row	500
Onion loader		3,500
Plow, moldboard	6 16"	2,000
Potato harvester	2 row	12,000
Potato planter	4 row	5,650
Rotary hoe	6 row	1,500
Shredder	4 row	1,350
Silage chopper	2 row	4,200
Transplanter	2 row	660
Vegetable planter	6 row	1,500
Miscellaneous equipment, tools, and repairs		4,000
BACKGROUNDING FEEDLOT[3]	1,000 head	46,300
SPRINKLER IRRIGATION SYSTEM		199,360

1 All 1280-acre farms will not have the same machinery and equipment inventory because of different combinations of crop and livestock enterprises. There will be specialized vegetable farms and specialized grain and roughage producing farms.
2 Horsepower ratings for tractors are based on 75 percent of drawbar rating.
3 Forty percent of the 1280-acre farms will have 1,000-head capacity backgrounding feedlot.

Table 5. Size and prices for machinery and equipment utilized on tribal operated enterprise farm, Navajo Indian Irrigation Project

Equipment	Size	New Price
		dollars
SELF-PROPELLED		
Tractor[1]	30 H.P.	5,580
Tractor[1]	40 H.P.	8,400
Tractor[1]	70 H.P.	10,000
Tractor[1]	90 H.P.	12,700
Combines		
Corn	4 row	13,050
Grain	18'	12,240
Edible bean	16'	11,970
Cucumber harvester	7'	23,400
Forklift		5,400
Hay cuber		32,400
Snap bean harvester	2 row	18,000
Sprayer	12 row	5,130
Swather	16'	5,130
Truck	18' tandem	6,660
IMPLEMENTS		
Asparagus harvester	2 row	6,000
Auger		485
Baler (PTO)		3,300
Beet harvester	2 row	7,740
Bin trailers		1,080
Blade	6'	450
Cabbage harvester		9,450
Carrot harvester		5,400
Chisel w/applicator	16'	1,620
Corn planter	6 row	2,655
Cultipacker	16'	810
Cultivator	6 row	1,080
Sidedress attachment	6 row	450
Disc, tandem	21'	1,746
Disc, border		342
Drill, squadron	2 14'	2,880
Electronic thinner	6 row	8,550
Fertilizer spreader	12'	540
Flail shredder	7'	880
Grain wagon	7.5 ton	2,500
Harrow	36'	675
Land plane	12 x 40'	2,700
Lister	6 row	990
Onion lifter	4 row	450
Onion loader		3,150
Plow moldboard	6 16"	1,800
Potato harvester	2 row	10,800
Potato planter	4 row	5,085
Rotary hoe	6 row	1,350
Silage chopper	2 row	3,780
Shredder	4 row	1,215
Transplanter	2 row	600
Vegetable planter	6 row	1,350
SPRINKLER IRRIGATION SYSTEM		167/acre

1 Horsepower ratings for tractors are based on 75 percent of drawbar rating.

Labor Requirements

Labor requirements for each crop were identified by quantity and type of skill for each period of the year. Labor requirements, by months, were grouped into four periods of 1) land preparation, covering December, January, February, and March, when much of the land would normally be prepared for planting; 2) planting, covering April and May, when most of the field and vegetable crops would be planted; 3) cultural operations, covering June, July, and August, when most of the irrigation, cultivation, spraying, harvesting of alfalfa hay, and harvesting of some vegetables would occur; and 4) harvesting, covering September, October, and November, when most of the field crops would be harvested along with some vegetables. Labor requirements were specified per planted acre. It was assumed that crops such as alfalfa, irrigated pasture, asparagus, and orchard crops would be produced on a continuous basis with the labor required for establishment prorated over the productive life of the crop or orchard. Total direct labor was increased by 10 percent to allow time to go and come from fields and for miscellaneous non-productive uses of labor. This was identified as downtime in the budgets.

Additional labor categories of supervision and management were identified on the enterprise farm budgets. Supervision charges were based on the hours and type of labor involved in the production of each crop as follows:

Type of Labor	Field Crops	Vegetable and Tree Crops
	supervision assessment in dollars per hour of direct labor	
Irrigation labor	.80	2.41
Machine labor	.40	.81
General labor		2.34

Management charges were based on five percent of the annual gross returns except for sugar beets, asparagus, and apples. Management was computed at 2.5 percent of gross returns on sugar beets because it was assumed the sugar beet processing facility would provide field supervisors. During the establishment periods for asparagus and apples, management was computed at five percent of the total expense until gross returns exceed total expense. After the establishment period the charge became five percent of the gross receipts.

Labor charges used in constructing the budgets on the enterprise farm were as follows:

General labor	$2.22 per hour
Semi-skilled labor	$3.00 per hour
Skilled labor	$4.20 per hour
Secretaries	$420 per month
Bookkeepers	$480 per month
Foremen-Assistant managers	$720 per month
Office managers	$960 per month
Managers	$1,440 per month

The above wage rates included all expenses that employers usually pay, such as Social Security, Workmen's Compensation, insurance programs and retirement, which, added together, amount to about 20 percent of the direct wage rate. The labor charge for each operation is based on the specific time required to perform the operation. Piece rates were used for selected packing shed and harvest operations for many of the vegetables budgets. The charge for packing carrots was computed at one-half cent per pound

and bell peppers at five cents per carton. The charge for sacking onions was 25 cents per field-run sack. The charge for picking bell peppers was 27 cents per carton.

Individually operated farms. All labor required on individually operated farms was charged at $2.22 per hour. This wage rate includes all expenses employers must pay. If the manager (operator) should perform any of the labor himself, the net return potential to the operator would be proportionally increased, depending on the number of hours devoted.

Irrigation System

An annual diversion of 508,000 acre-feet of irrigation water from the Navajo Reservoir will be used for the 110,630-acre Navajo Indian Irrigation Project lands. The efficiency of the delivery system to the Project site was estimated by the Bureau of Indian Affairs and Bureau of Reclamation to be approximately 70 percent. This would result in delivery of 3.25 acre-feet of water per acre to the land.

Quantities of irrigation water required by the different crops were estimated, using the method devised by Blaney and Hanson (1). Essentially, this method utilizes the consumptive-use requirements and subtracts effective precipitation to get the plant's water requirement. The field irrigation requirements were estimated for the different crops from consumptive use and irrigation efficiencies. The irrigation requirements were based on a 70-percent irrigation efficiency.

Costs of the irrigation system were specified on a per acre basis, regardless of the amount of irrigation water delivered. The sidewheel movement system used on the 320- and 640-acre farms had an annual fixed cost of $6.55 per acre and variable cost of $1.60 per acre (table 6). An operation and maintenance cost of $11.00 per acre was estimated for the main conveyance system from the Navajo Dam to the fields which brought the total annual operating cost of the sidewheel irrigation system to $19.15 per acre.

The 1280-acre farm and the tribal enterprise farm were assumed to use a combination of 45-percent sidewheel movement system, 45-percent pivot system, and 10-percent solid set. The combination irrigation system budgeted for the 1280-acre farm and tribal enterprise farm had a annual fixed cost of $10.93 per acre and variable cost of $1.90 per acre (table 6). With an operation and maintenance cost of $11.00 per acre for the conveyance system, the total per-acre annual cost of the combination system was $23.83. A detailed itemization of the annual fixed and variable costs on a 160-acre basis is presented in table 6.

Capital

Capital needs for individual and tribal enterprise farms were divided into "investment capital", the amount of money required to purchase machinery, equipment, and facilities, and "operational capital",

Table 6. Investment and annual operating costs for sprinkler irrigation systems on 160-acre basis, Navajo Indian Irrigation Project

Item	System			
	Solid Set	Pivot	Wheel movement[1]	Combination[2]
	. . . . . dollars			
FIXED COST (160-acre basis)				
New	80,000.00	21,600.00	16,000.00	24,920.00
Life	15 years	15 years	15 years	15 years
Salvage	5,333.00	1,440.00	1,067.00	1,661.00
Depreciation[3]	4,978.00	1,344.00	996.00	1,551.00
Insurance ($3.25 per $1,000 valuation)	260.00	70.00	52.00	81.00
Total cost	5,238.00	1,414.00	1,048.00	1,632.00
Cost per acre	32.74	10.47[4]	6.55	10.93
VARIABLE COST (160-acre basis)				
Repairs and maintenance	160.00	384.00	256.00	304.00
Total costs	160.00	384.00	256.00	304.00
Cost per acre	1.00	2.40	1.60	1.90

1 Budgets for 320- and 640-acre farms were based on wheel movement systems.
2 Sprinkler combination used in the crop budgets for 1280-acre farm and tribal enterprise farm consisted of 10-percent solid set, 45-percent pivot, and 45-percent wheel movement.
3 Depreciation is based on a 15-year life.
4 Pivot irrigation system is based on 135-irrigated acres per 160-crop acres.

which was the amount of money necessary to operate the farms for a typical year.

Total investment capital included the purchase of machinery and tractors for each farm size, on the basis of 1970 new prices. (See the previous section on machinery costs.) Machinery inventories including the size and price of the equipment are presented in New Mexico Agricultural Experiment Station Research Reports 194 and 199. The sum of the equipment costs for each farm size, plus the cost of the sprinkler irrigation system, was the amount of investment capital required for farming activities for a given farm size.

Operational capital included the amount of cash required to operate the farm for one year. This amount included labor; variable costs such as fuel, maintenance, and repair costs; and an additional $12.60 per-acre charge ($11.00 conveyence charge plus $1.60 sprinkler maintenance) on 320- and 640-acre farms and $12.90 ($11.00 conveyence charge plus $1.90 sprinkler maintenance) on the 1280-acre and the enterprise farm budgets. The costs of seed, fertilizer, and chemicals were also included in the operational capital estimates.

Land Charge

A cash rent charge of $20 per acre was included as a cost for the 320-, 640-, and 1280-acre farms. It was assumed that this rent would be paid by the individual Navajo farmer to the Navajo Tribe for use of the land and to offset the cost of some of the services provided. For the tribal enterprise farm,a land charge was not included because of tribal ownership and management of the farm business. The cost of the services provided by the $20 per acre land rent fee to the individual farms is a regular operating cost for the tribal enterprise farm.

Measures of Profit

Tribal enterprise farm. The measure of profits used for the tribal enterprise farm was net return to land and capital. Land charges, interest expenses on investment and operating capital, and taxes were not included as expense items in the crop budgets. These costs are considered in a later section of this report and were not included as expense items in crop budgets. All other expenses were charged to the crops.

Individually operated farms. The measure of profit used for the 320-, 640-, and 1280-acre farms was net return to land, capital, and management. Interest charges on investment and operating capital, taxes, or any administration overhead were not included as costs in the crop budgets. These factors are considered in a later section of this report.

In a comparison of crop budgets for the tribal enterprise farm and the individually operated farm, the land charge of $20 per acre can be removed from the individual farm budgets as a cost item. This would result in a measure of profits similar to the one used for the tribal enterprise farm. The only difference would be that the individually operated farm budgets would not contain a comparable charge for management and supervision. For the individually operated farms, it was assumed that the farm operator would perform the management function in the normal day-to-day routines.

Crop Yields

Crop yields were estimated by New Mexico State University's research team and the advisory committee. Crop yields on the individually operated farms were expected to be slightly lower on the average than those obtained

on the tribal enterprise farm. Crop yields on the tribal enterprise farm were considered to be obtainable averages over a period of years with superior management. The cost of obtaining the services of superior management talent was included as an expense item in the tribal enterprise farm budgets. Crop yields on the individually operated farms of 320, 640, and 1280 acres were considered as obtainable averages over a period of years under good management. It was assumed there would likely be some superior individual farm operators, some good farm operators, some average, and some below-average farm operators. For purposes of estimating yields in this study, it was assumed that the overall level of management on the individually operated farms would be average to good in ability.

These assumptions on crop yields apply only for short-range planning. Factors such as training and experience of Navajo farmers, changes in cultural practices, and development of new varieties make it necessary to constantly re-evaluate estimates of yield.

Prices

Product prices were based on average prices received in New Mexico, primarily for the period 1967 through 1969. For crops not commercially produced in New Mexico, prices were based on information from other states. Sources included vegetable processors, trade association, and the Crop and Livestock Reporting Service, U. S. Department of Agriculture.

For the tribal enterprise farm, prices for crops include value added from storage, packing, grading, and handling functions where applicable. Cost of performing these functions were included in the budgets for the tribal enterprise farm. Prices were based on f.o.b. packing shed, grain elevator, or other first pricing point. Prices for vegetables intended for processing

included harvest and delivery to the cannery but excluded the value added by processing.

On the individually operated farms, it was assumed all field crops would be sold either in the field or to local grain elevators, canneries, and packing sheds.

Prices are higher for dry beans, soybeans, all grains, and alfalfa seeds on the tribal enterprise farm due to the additional value added as the result of performing further assembly, storage, and marketing functions. Prices for all other crops and livestock were the same for each farm organizational approach.

A summary of the crop budgets including yields, prices, gross returns, total costs, and net returns per acre is presented for the 320-acre farm in table 7, 640-acre farm in table 8, for the 1280-acre farm in table 9, and for the tribal enterprise farm in table 10.

Description of Field Crop Budgets

Yields of field crops on the tribal enterprise farm were budgeted to average 16 percent above the individually operated farms. Gross returns per acre were expected to average 24 percent above gross returns per acre from individually operated farms. The larger increase in gross returns compared to yields was due to the predicted greater yields and higher prices on the tribal enterprise farm. The higher prices budgeted for the tribal enterprise farm for some commodities were the result of initial processing and storage functions being performed by the tribal enterprise farm, which increased the selling prices. It was assumed that these processing and storage functions would not be performed on the individually operated farms.

The assumption of 16 percent greater yields for the tribal enterprise farm was based on the assumption of superior management on the enterprise

Table 7. Estimated yields, prices, costs, gross returns, and net returns, per acre for selected crops, for 320-acre farm, Navajo Indian Irrigation Project

Crop	Unit	Yield per Acre	Price per Unit	Gross Return per Acre	Total Cost per Acre	Net Return to Land, Capital, and Management[1]
			dollars			
FIELD CROPS						
Sugar beets				253.12	189.83	83.29
Beets	ton	16	13.32	213.12		
Tops	ton	8	5.00	40.00		
Alfalfa hay (baled)	ton	5	27.91	139.55	101.98	57.57
Dry beans	cwt.	16	7.25	116.00	119.30	16.70
Soybeans	bu.	30	2.55	76.50	87.13	9.37
Grain sorghum	cwt.	50	1.90	95.00	114.86	0.14
Corn grain	bu.	107	1.20	128.40	127.76	20.64
Corn silage	ton	19	7.50	142.50	146.28	16.22
Winter barley				113.58	107.54	26.04
Grain	bu.	86	1.03	88.58		
Grazing				25.00		
Winter wheat				112.77	93.09	39.68
Grain	bu.	67	1.31	87.77		
Grazing				25.00		
Irrigated pasture					77.49[2]	
SEED CROPS						
Alfalfa seed				312.09	145.49	186.60
Seed	lb.	420	.66	277.20		
Hay	ton	1.25	27.91	34.89		
VEGETABLE CROPS						
Asparagus (established)	ton	1.89	354.00	669.06	225.40	463.66
Beets	ton	13	22.00	286.00	244.05	61.95
Bell peppers	cwt.	126	7.75	976.50	581.42	415.08
Cabbage	ton	17	18.80	319.60	249.48	90.12
Carrots (fresh)	cwt.	220	6.00	1,320.00	1,156.83	183.17
Carrots (processed)	ton	23	22.50	517.50	275.83	261.67
Cucumbers (processed)	cwt.	73	4.60	335.80	235.79	120.01
Onions	cwt.	295	3.46	1,020.70	984.84	55.86
Potatoes (fresh)	cwt.	240	3.00	720.00	694.18	45.82
Snap beans	ton	2.50	98.50	246.25	196.34	69.91
Sweet potatoes	ton	6.25	44.00	275.00	241.34	53.66

1 Excludes taxes, administrative overhead, and a $20 per acre land rent charge.
2 Excludes $20 land rent charge.

Table 8. Estimated yields, prices, costs, gross returns and net returns per acre for selected crops, for 640-acre farm, Navajo Indian Irrigation Project

Crop	Unit	Yield per acre	Price per Unit	Gross Return per Acre	Total Cost per Acre[1]	Net Return to Land, Capital, and Management[1]
			. . . . .		dollars	. . . . .
FIELD CROP						
Sugar beets				253.12	183.11	90.01
Beets	ton	16	13.32	213.12		
Tops	ton	8	5.00	40.00		
Alfalfa hay (baled)	ton	5	27.91	139.55	94.69	64.86
Dry beans	cwt.	16	7.25	116.00	110.25	25.75
Soybeans	bu.	30	2.55	76.50		
Grain sorghum	cwt.	50	1.90	95.00	104.91	10.09
Corn grain	bu.	107	1.20	128.40	118.06	30.34
Corn silage	ton	19	7.50	142.50	139.26	23.24
Winter barley				113.58	103.41	30.17
Grain	bu.	86	1.03	88.58		
Grazing				25.00		
Winter wheat				112.77	88.96	43.81
Grain	bu.	67	1.31	87.77		
Grazing				25.00		
Irrigated pasture					74.72[2]	
SEED CROPS						
Alfalfa seed				312.09	139.12	192.97
Seed	lb.	420	.66	277.20		
Hay	ton	1.25	27.91	34.89		
VEGETABLE CROPS						
Asparagus (established)	ton	1.89	354.00	669.06	221.40	467.66
Beets	ton	13	22.00	286.00	238.07	67.93
Bell peppers	cwt.	126	7.75	976.50	575.12	421.38
Cabbage	ton	17	18.80	319.60	241.81	97.79
Carrots (fresh)	cwt.	220	6.00	1,320.00	1,150.53	189.47
Carrots (processed)	ton	23	22.50	517.50	269.53	267.97
Cucumbers (processed)	cwt.	73	4.60	335.80	227.96	127.89
Onions	cwt.	295	3.46	1,020.70	976.78	63.92
Potatoes (fresh)	cwt.	240	3.00	720.00	688.20	51.80
Snap beans	ton	2.50	98.50	246.25	189.14	77.11
Sweet potatoes	ton	6.25	44.00	275.00	233.48	61.52

1 Excludes taxes, administrative overhead, and a $20 per acre land rent charge.
2 Excludes $20 land rent charge.

Table 9. Estimated yields, prices, costs, gross returns, and net returns per acre for selected crops, for 1280-acre farm, Navajo Indian Irrigation Project

Crop	Unit	Yield per Acre	Price per Unit	Gross Return per Acre	Total Cost per Acre	Net Return to Land, Capital, and Management[1]
				dollars		
FIELD CROPS						
Sugar beets				253.12	147.46	125.66
Beets	ton	16	13.32	213.12		
Tops	ton	8	5.00	40.00		
Alfalfa hay (cubed)	ton	5	34.53	172.65	117.49	75.16
Dry beans	cwt.	16	7.25	116.00	97.55	38.45
Soybeans	bu.	30	2.55	76.50	71.52	24.98
Grain sorghum	cwt.	50	1.90	95.00	94.20	20.80
Corn grain	bu.	107	1.20	128.40	101.03	47.37
Corn silage	ton	19	7.50	142.50	104.09	58.41
Winter barley				113.58	89.09	44.49
Grain	bu.	86	1.03	88.58		
Grazing				25.00		
Winter wheat				112.77	78.33	54.44
Grain	bu.	67	1.31	87.77		
Grazing				25.00		
Irrigated pasture					71.92[2]	
SEED CROPS						
Alfalfa				312.09	133.38	198.71
Seed	lb.	420	.66	277.20		
Hay	ton	1.25	27.91	34.89		
VEGETABLE CROPS						
Asparagus (established)	ton	1.89	354.00	669.06	217.15	471.91
Beets	ton	13	22.00	286.00	227.00	79.00
Bell peppers	cwt.	126	7.75	976.50	561.46	435.04
Cabbage (processed)	ton	17	18.80	319.60	228.11	111.49
Carrots (fresh)	cwt.	220	6.00	1,320.00	1,138.14	201.86
Carrots (processed)	ton	23	22.50	517.50	257.14	280.36
Cucumbers (processed)	cwt.	73	4.60	335.80	215.42	140.38
Onions	cwt.	295	3.46	1,020.70	962.61	78.09
Potatoes (fresh)	cwt.	240	3.00	720.00	673.73	66.27
Snap beans	ton	2.50	98.50	246.25	182.00	84.25
Sweet potatoes	ton	6.25	44.00	275.00	227.10	67.90

1 Excludes taxes, administrative overhead, and a $20 per acre land rent charge.
2 Excludes $20 land rent charge.

Table 10. Yields, prices received, costs, gross returns, and net returns, per acre for selected crops, tribal enterprise farm, Navajo Indian Irrigation Project

Crop	Unit	Yield per Acre	Price per Unit	Gross Return per Acre	Total Cost per Acre	Net Return per Acre[1]
				dollars		
FIELD CROPS						
Sugar beets				329.72	136.39	193.33
Beets	ton	21	13.32	279.72		
Tops	ton	10	5.00	50.00		
Alfalfa hay (cubed)	ton	6	34.53	207.18	101.85	105.33
Dry beans	cwt.	18.7	8.50	158.95	92.16	66.79
Soybeans	bu.	34	2.64	89.76	61.29	28.47
Grain sorghum	cwt.	60	1.99	119.40	88.60	30.80
Corn grain	bu.	119	1.29	153.51	101.34	52.17
Corn silage	ton	21	7.50	157.50	90.93	66.57
Winter barley				128.23	79.98	48.25
Grain	bu.	93	1.11	103.23		
Grazing				25.00		
Winter wheat				125.80	69.40	56.40
Grain	bu.	72	1.40	100.80		
Grazing				25.00		
Irrigated pasture					70.39	
SEED CROPS						
Alfalfa seed				191.87	127.99	263.88
Seed	lb.	500	.70	350.00		
Hay	ton	1.5	27.91	41.87		
VEGETABLE CROPS						
Asparagus (established)	ton	2.25	354.00	796.50	175.53	620.97
Beets	ton	15	22.00	330.00	272.47	57.53
Bell peppers	cwt.	150	7.75	1,162.50	882.80	279.70
Cabbage	ton	20	18.80	376.00	208.87	167.13
Carrots (fresh)	cwt.	260	6.00	1,560.00	884.59	675.41
Carrots (processed)	ton	27	22.50	607.50	214.44	393.06
Cucumbers (processed)	cwt.	87	4.60	400.20	244.55	155.65
Onions	cwt.	350	3.46	1,211.00	1,048.55	162.45
Potatoes (fresh)	cwt.	280	3.00	840.00	611.62	228.38
Snap beans	ton	3	98.50	295.50	189.80	105.70
Sweet potatoes	ton	7	44.00	308.00	265.35	42.65
ORCHARD ENTERPRISES						
Apples	box	300	2.67	2,156.00	2,094.14	41.86

1 Net return to land and capital. Land charges, interest on investment and operating capital, and taxes are not included as expense items.

farm. It was assumed that the managers and crop specialists hired by the Board of Directors for the tribal enterprise farm would be able to obtain greater yields than the average of individual Navajo farmers. It is most likely that the best of the individual farmers would obtain yields equal to or greater than those obtained by the tribal enterprise farm. But, given the lack of training and farming experience among the Navajo people, the research team decided it was unrealistic to assume that the average of all individual farmers would be able to obtain superior yields.

The total per acre costs for field crops were lower on the tribal enterprise farm than on the individually operated farms. These costs ranged from 10 percent below on the 1280-acre farm to 30 percent below on the 320-acre farm. The higher costs per acre for the individual farms were due primarily to differences in machinery efficiency, custom harvesting of field crops on the 320- and 640-acre farms, and a land rent charge of $20 per acre on the individually operated farms. Net return to land and capital (and management on the individually operated farms) varied widely between the four farm sizes. The tribal enterprise farm, even after allowing for the $20 per acre land rent charge to individual farms, had the highest average net return, followed by the 1280-acre farm, 640-acre farm, and the 320-acre farm. The difference between the 320-acre farm and the 1280-acre farm can be attributed to labor and machinery efficiency. The differences in net returns between the tribal enterprise farm and individually operated farms can be attributed to yields, prices of inputs and products, machinery and labor efficiency, and no custom harvesting of the field crops on the tribal enterprise farm.

Sugar beets. Sugar beets in the project area are typically planted between the end of March and the middle of May and harvested during late October or early November. For disease control, crops should be rotated to include sugar beets not more than once every three or four years.

It was assumed that no more than one-fifth of the acreage in the Navajo Indian Irrigation Project would be planted in sugar beets on the tribal enterprise farm during any one year, and no more than one-fourth of the project acreage would be planted in sugar beets on the individually operated farms. The project acreage alone could support a sugar refinery if approximately 30,000 acres were in sugar beets. It was also assumed sugar beets would be produced on nearby non-project land. Government support payments were included in the price of sugar beets. It was anticipated that the sugar beet tops on the project would be chopped into silage and used as cattle feed.

Sugar beet yield on the tribal enterprise farm was budgeted at 21 tons of beets and 10 tons of beet tops per acre, while on the individually operated farms yields were assumed to be 16 tons of beets and 8 tons of tops. Gross returns per acre ranged from $329.72 per acre on the tribal enterprise farm to $253.12 per acre on the 320-acre farm. Costs varied from a low on the tribal enterprise farm of $135.39 to a high on the 320-acre farm of $189.83 per acre. The differences in costs were due primarily to the efficiency in machine use, land rental charge on the individually operated farms, and custom harvesting on the 320- and 640-acre farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $193.33 per acre on the tribal enterprise farm to $83.29 on the 320-acre farm. The differences in net returns between the tribal enterprise farm and the individually operated farms were due primarily to differences in yields and costs.

Alfalfa. Alfalfa was considered by the research team to be the major forage crop for the project and is typically planted in late summer or early

fall. No harvest was expected during the year the alfalfa was established, but four cuttings per year could be expected after that. Baling was assumed to be the method of harvesting on the 320- and 640-acre farms, but cubing was assumed to be the method of harvesting on the 1280-acre and enterprise farms. The productive life span of an alfalfa stand was assumed to be five years; therefore, one-fifth of the establishment cost was charged as an annual cost in the budgets.

The annual yield was budgeted at six tons per acre on the tribal enterprise farm and five tons per acre on the individually operated farms. Gross returns varied from $207.18 per acre on the tribal enterprise farm to $139.55 per acre on the 320- and 640-acre farms. Gross returns were budgeted at $172.65 per acre on the 1280-acre farms. Total costs per acre varied from a low of $94.69 on the 640-acre farm to $117.49 per acre on the 1280-acre farm, with the tribal enterprise farm about midway between at $101.85 per acre. Baling as the method of harvesting was the primary reason the two small farms had lower costs. However, when the land rental charge is subtracted from the budgets for the individually operated farms, then the individually operated farms would have a lower total cost than the tribal enterprise farm. Net return per acre to land and capital ranged from $105.33 on the tribal enterprise farm to $57.57 on the 320-acre farm.

Dry beans. Dry beans grown in northwestern New Mexico are planted from middle to late May and are harvested in early November.

Yields were 18.7 hundredweight per acre on the tribal enterprise farm and 16 hundredweight on the individually operated farms. Gross returns per acre ranged from $158.95 per acre on the tribal enterprise farm to $116.00 per acre on the individually operated farms. Costs varied from a low on the

tribal enterprise farm of $92.16 to a high on the 320-acre farm of $119.30 per acre. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $66.79 per acre on the tribal enterprise farm to $16.70 on the 320-acre farm.

Soybeans. Soybeans are normally planted between May 1 and May 20. The crop is typically harvested during the month of October or early November. However, very few soybeans are grown in the region at the present time. Yields were budgeted at 34 bushels per acre on the tribal enterprise farm and 30 bushels on the individually operated farms. Estimates of gross returns per acre ranged from $89.76 on the tribal enterprise farm to $76.50 on the individually operated farms. Costs varied from a low of $61.29 per acre on the tribal enterprise farm to a high on the 320-acre farm of $87.31 per acre. The differences in costs were due primarily to the efficiency in machine use, land rental charge on the individually operated farms, and custom harvesting on the 320- and 640-acre farms. Net returns per acre to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms ranged from $28.47 on the tribal enterprise farm to $9.37 on the 320-acre farm. The differences in net returns were due to differences in yields and costs.

Grain sorghum. Grain sorghum is planted about the middle of May and is harvested between the middle of October and the middle of December.

Yield of grain sorghum on the tribal enterprise farm was estimated 60 hundredweight per acre compared to 50 hundredweight on the individually operated farms. Gross returns per acre ranged from $119.40 per acre on

the tribal enterprise farm to $95.00 per acre on the 320-acre farm. Costs varied from a low on the tribal enterprise farm of $88.60 to a high on the 320-acre farm of $114.86 per acre. The differences in costs were due primarily to the efficiency in machine use and custom harvesting on the 320- and 640-acre farms and the land rental charge on the individually operated farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $30.80 per acre on the tribal enterprise farm to $0.14 on the 320-acre farm. The differences in net returns between the tribal enterprise farm and the individually operated farms were due to differences in prices, yields, costs, and functions performed.

Corn for grain. Corn for grain is typically planted from mid-April to the first of May in northwestern New Mexico and harvested in October and November.

Average yield on the tribal enterprise farm was budgeted at 119 bushels per acre compared to 107 bushels on the individually operated farms. Gross returns per acre ranged from $153.51 per acre on the tribal enterprise farm to $128.40 per acre on the individually operated farms. Costs varied from a low on the tribal enterprise farm of $101.34 to a high on the 320-acre farm of $127.76 per acre. The differences in costs were due primarily to the efficiency in machine use and custom harvesting on the 320- and 640-acre farms, and the land rental charge of $20 per acre on the individually operated farms. Without the land charge of $20 per acre the 640- and 1280-acre farms would have lower total per-acre costs than the tribal enterprise farm and the 320-acre farm costs would be only slightly higher. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $52.17 per acre

on the tribal enterprise farm to $20.64 on the 320-acre farm. The differences in net returns were due to differences in prices, yields, costs, and functions performed.

Corn for silage. Corn silage is normally planted from mid-April to the first of May and harvested as silage from mid-August to mid-September.

Average yields were estimated at 21 tons per acre on the tribal enterprise farm and 19 tons on the individually operated farms. Gross returns per acre ranged from $157.50 on the tribal enterprise farm to $142.50 on the 320-acre farm. Costs varied from a low on the tribal enterprise farm of $90.93 to a high on the 320-acre farm of $146.28 per acre. The differences in costs were due primarily to the efficiency in machine use and custom harvesting on the 320-acre farm. The total per acre production cost is lower on the 1280-acre farm than on the tribal enterprise farm after adjusting for the $20 per acre land rent charge. Costs on the 640-acre farm is only slightly higher. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms ranged from $66.57 per acre on the tribal enterprise farm to $16.22 on the 320-acre farm. The differences in net returns between the tribal enterprise farm and the individually operated farms were due to differences in yields, prices, and costs.

Winter barley. Winter barley is typically planted from September 1 to September 20 in northwestern New Mexico. During late fall, winter, and early spring months, the barley would be used for pasture. Income from grazing was estimated at $25.00 per acre. Barley for grain is harvested in late June.

Average yield on the tribal enterprise farm was budgeted at 93 bushels per acre compared to an expected average yield of 86 bushels per acre on the individually operated farms. Gross returns per acre ranged from $128.23 per acre on the tribal enterprise farm to $113.58 per acre on the 320-acre farm. Costs varied from a low on the tribal enterprise farm of $79.98 to a high of $88.96 on the 320-acre farm. The differences in costs were due primarily to the efficiency in machine use and custom harvesting on the 320- and 640-acre farms. Net returns to land and capital on the tribal enterprise farm and to land, capital, and management on the individually operated farms ranged from $48.25 per acre on the tribal enterprise farm to $26.04 on the 320-acre farm. The differences in net returns were due primarily to differences in yields and costs.

Winter wheat. Winter wheat is planted during early September. The winter wheat is pastured in the late fall, winter, and the spring. Income from a three-month grazing period was estimated at $25.00 per acre. The crop is usually harvested during the first two weeks of July.

Yield on the tribal enterprise farm was budgeted at 72 bushels per acre compared to 67 bushels for the individually operated farms. Gross returns per acre ranged from $125.80 per acre on the tribal enterprise farm to $112.77 per acre on the individually operated farms. Costs varied from a low on the tribal enterprise farm of $69.40 to a high on the 320-acre farm of $93.09 per acre. The differences in costs were due primarily to the efficiency in machine use and custom harvesting on the 320- and 640-acre farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $56.40

per acre on the tribal enterprise farm to $39.68 on the 320-acre farm. The differences in net returns were due primarily to differences in yields and costs.

Irrigated pasture. Irrigated pasture can be planted in either late spring or early fall with a companion crop. Since no benefit is derived from the pasture the year it is planted, the establishment cost was prorated over a period of 10 years--the expected productive life of the pasture. The net return of the pasture can be in the form of rent or the return on the gain made by the calves from the beef breeding herd, cull cows, and bulls, or by grazing yearlings.

The annual costs of the irrigated pasture did not vary much between farm sizes; $70.39 per acre on the tribal enterprise farm to $77.49 on the 320-acre farm. However, if the land rental charge is subtracted from total costs on individually operated farms, then the 1280-acre farm total cost would be $51.92 per acre; 640-acre farm, $54.72; and the 320-acre farm, $57.49 per acre.

Alfalfa seed. Alfalfa for seed is planted in late summer or early fall. No harvest was expected during the year the alfalfa was established, but thereafter one seed crop would be produced each year. In addition, it was estimated that 1.25 tons of hay would be produced at the regular first-cutting time for alfalfa hay on the individually managed farms and 1.5 tons on the tribal enterprise farm. The seed crop is normally combined in August or early September.

Expected gross returns ranged from $391.87 per acre on the tribal enterprise farm to $312.09 per acre on the 320-acre farm. Costs varied from a low on the tribal enterprise farm of $127.99 to a high on the 320-acre

farm of $145.49 per acre. The differences in costs were due primarily to the land rent charge of $20 per acre on individually operated farms. If the land rent charge of $20 per acre were subtracted from the total costs, then the 1280-acre farm would have the lowest cost at $113.38 per acre; the 640-acre farm costs would be $119.12 per acre; and the 320-acre farm at $125.49 per acre. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $263.88 per acre on the tribal enterprise farm to $186.60 on the 320-acre farm. The differences in expected net returns were due to differences in yields, prices, and costs.

Description of Vegetable Crop Budgets

Yields and gross returns of vegetable crops on the tribal enterprise farm were budgeted to average 17.5 percent above the yields on individually operated farms. The tribal enterprise farm was assumed to process all of the vegetables produced through its own processing plant and own and operate a fresh vegetable marketing firm. The individually operated farms were assumed to market the fresh vegetables through a tribal owned or producer cooperative marketing firm and to sell processing vegetables to processing firms owned by the Navajo Tribe. The tribal business or farmer cooperative was budgeted to provide custom harvesting, packaging, and brokerage services on a fee basis to the individual farms. Because of these similar marketing and processing systems, farm level prices of fresh and processed vegetables were assumed to be the same for the tribal enterprise farm and the individually operated farms. Twelve fresh and processing vegetables were considered as possible crops.

Fresh market:	bell peppers	onions
	carrots	potatoes
Processed:	asparagus	cucumbers
	beets	potatoes
	cabbage	snap beans
	carrots	sweet potatoes

Bell peppers. Bell peppers are planted in early May and hand-harvested in August. The yield was budgeted at 150 hundredweight per acre of salable produce on the tribal enterprise farm and 126 hundredweight on the individually operated farms. Gross returns per acre ranged from $1,162.50 on the tribal enterprise farm to $976.50 on the individually operated farms. Costs varied from a low on the 1280-acre farm of $561.46 to a high on the tribal enterprise farm of $882.80 per acre. The differences in costs were due primarily to custom harvesting on the individually farms which cost more than the crew labor maintained by the tribal enterprise farm. However, a management charge of $182.38 per acre on the tribal enterprise farm more than offset the higher harvesting costs on the individually operated farms resulting in these farms having lower total budgeted costs. Without the land charge of $20 per acre included, the individually operated farms would have even lower total per-acre costs than the tribal enterprise farm. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $279.70 per acre on the tribal enterprise farm to $435.09 on the 1280-acre farm. The differences in net returns were due to differences in costs arising from the substantial supervision and management assessment on the tribal enterprise farm.

Carrots (fresh). Carrots (fresh) are typically planted in early April and mechanically harvested from the middle of July through October. The yields reported in the budgets are marketable yields--260 hundredweight on the tribal enterprise farm and 220 hundredweight on the individually operated farms. Gross returns per acre ranged from $1,560.00 on the tribal enterprise farm to $1,320.00 on the individually operated farms. Costs varied from a low on the tribal enterprise farm of $884.59 to a high on the 320-acre farm of $1,156.83 per acre. The differences in costs were due primarily to custom harvesting on the individually operated farms, and the land rental charge of $20 per acre on the individually operated farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $279.70 per acre on the tribal enterprise farm to $183.17 on the 320-acre farm. The major differences in net returns among farm sizes were due to differences in yields and costs of harvesting carrots.

Onions. Onions are planted in early April and harvested by hand in early September. The yields per acre reported in the budgets are marketable yields--350 hundredweight for the tribal enterprise farm and 295 hundredweight for the individually operated farms. Gross returns per acre ranged from $1,211.00 on the tribal enterprise farm to $1,020.70 on the individually operated farms. Costs per acre varied from a low of $962.61 on the 1280-acre farm to a high of $1,048.55 on the tribal enterprise farm. The differences in per-acre costs were due primarily to the supervision and management charge of $252.46 per acre on the tribal enterprise farm and high harvesting costs on the individual farms. Harvesting costs on the tribal enterprise farm were about $200 lower per acre than on the individually operated farms,

but the supervision and management charge on the tribal enterprise farm more than offset the lower harvesting costs. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms, ranged from $162.45 per acre on the tribal enterprise farm to $55.86 on the 320-acre farm. The major differences in net returns were due to the higher yield on the tribal enterprise farm.

Potatoes. Potatoes are normally planted in early April and harvested mechanically about mid-August. The cull potatoes from the fresh pack were budgeted for use in the vegetable processing plant. Small potatoes are undesirable for the fresh market but ideal for several processed items.

Marketable yield was budgeted at 280 hundredweight per acre on the tribal enterprise farm and 240 hundredweight on the individually operated farms. Gross returns per acre ranged from $840.00 on the tribal enterprise farm to $720.00 on the individually operated farms. Costs varied from a low on the tribal enterprise farm of $611.62 to a high on the 320-acre farm of $694.18 per acre. The differences in costs were due primarily to custom harvesting on the individually operated farms, differences in costs of purchased inputs, and the land rental charge of $20 per acre on the individually operated farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital,and management on the individually operated farms, ranged from $228.38 per acre on the tribal enterprise farm to $45.82 on the 320-acre farm. The differences in net returns were due to both differences in yields and costs of production.

Asparagus. Asparagus is best planted in June. It requires three years before an asparagus bed is fully established but a small quantity could be harvested during the third year. It was assumed that full production would be reached in the fourth year and continue through the fourteenth year. The first and second year establishment costs were compounded at seven percent interest and prorated over the life of the asparagus bed.

The harvesting season for northwestern New Mexico typically runs from the middle of April through mid-June. Asparagus has in the past been harvested by hand. However, harvesting machines have been developed that function reasonably well for processing asparagus on sandy soils in dry climates. The budgets prepared for all sizes of farms were based on machine harvesting.

The budgeted yield was 2.25 tons per acre on the tribal enterprise farm and 1.89 tons on the individually operated farms. Gross returns per acre were $796.50 on the tribal enterprise farm compared to $669.06 on the individually operated farms. Costs per acre varied from a low on the tribal enterprise farm of $175.53 to a high on the 320-acre farm of $225.40. The differences in costs were due primarily to the efficiency in machine use, custom harvesting on the individually operated farms, and the land rental charge of $20 per acre on the individually operated farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms ranged from $620.97 per acre on the tribal enterprise farm to $463.66 on the 320-acre farm. The differences in net returns were due to differences in yields and costs of production.

Beets for processing. Beets for processing are planted in late spring to early summer and harvested from midsummer to frost. It was assumed that beets would be harvested mechanically.

The expected yield on the tribal enterprise farm was 15 tons per acre compared to 13 tons on the individually operated farms. Gross returns per acre ranged from $330.00 per acre on the tribal enterprise farm to $286.00 per acre on the individually operated farms. Costs varied from a low on the 1280-acre farm of $227.00 to a high on the tribal enterprise farm of $272.47 per acre. The differences in costs were due primarily to the high supervision and management charge on the tribal enterprise farm. Purchased inputs and preharvest operations were lower on the tribal enterprise farm than on the individually operated farms, but harvesting operations and supervision and management charges were higher for the tribal enterprise farm. Without a land charge of $20 per acre the individually operated farms would have significantly lower total per-acre costs than the tribal enterprise farm. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms ranged from a low of $57.53 per acre on the tribal enterprise farm to $79.00 on the 1280-acre farm. The differences in net returns were primarily due to differences in cost of production.

Cabbage. Cabbage is normally planted in late March and harvested mechanically in August and September for processing.

The yields per acre were budgeted at 20 tons per acre on the tribal enterprise farm and 17 tons on the individually operated farms. Gross returns per acre ranged from $376.00 on the tribal enterprise farm to $319.60 on the individually operated farms. Costs varied from a low on

the tribal enterprise farm of $208.87 to a high on the 320-acre farm of $249.48 per acre. The differences in costs were due primarily to the efficiency in machine use, custom harvesting on the 320- and 640-acre farms, and the land rental charge of $20 per acre on the individually operated farms. Without the land charge of $20 per acre, the 640- and 1280-acre farms would have about the same total per-acre costs as the tribal enterprise farm and the costs on the 320-acre farm would be slightly higher. Net returns to land and capital on the tribal enterprise farm, and to land, capital and management on the individually operated farms ranged from $167.13 per acre on the tribal enterprise farm to $90.12 on the 320-acre farm. The differences in net returns were due to differences in yields and costs of production.

Carrots (processed). Carrots (processed) are normally planted about mid-April and mechanically harvested from mid-July through October.

The yields per acre were budgeted at 27 tons per acre on the tribal enterprise farm and 23 tons on the individually operated farms. Gross returns per acre ranged from $607.50 per acre on the tribal enterprise farm to $517.50 per acre on the individually operated farms. Costs varied from a low on the tribal enterprise farm of $214.44 to a high on the 320-acre farm of $241.67 per acre. The differences in costs were due primarily to the efficiency in machine use, custom harvesting on the individually operated farms, and the land rental charge of $20 per acre on the individually operated farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital and management on the individually operated farms ranged from $393.06 per acre on the tribal enterprise farm to $261.67 on the 320-acre farm. The differences in net returns were due to differences in yield and costs of production.

Cucumbers (processed). Cucumbers (processed) are planted from mid-May through mid-July and harvested mechanically from mid-July through September.

The yields per acre were budgeted at 87 hundredweight on the tribal enterprise farm and 73 hundredweight on the individually operated farms. This yield estimate is based on a blend of pickle products ranging in size from small to large. Gross returns per acre ranged from $400.20 on the tribal enterprise farm to $335.80 on the individually operated farms. Costs per acre varied from a high on the tribal enterprise farm of $244.55 to a low of $215.42 on the 1280-acre farm. The differences in costs were due primarily to lower custom harvesting on the individually operated farms and to the high supervision and management charge on the tribal enterprise farm. Without a land charge of $20 per acre,the 1280-acre farm would have lower total per-acre costs than the tribal enterprise farm. Net returns to land and capital on the tribal enterprise farm, and to land, capital and management on the individually operated farms ranged from $155.65 per acre on the tribal enterprise farm to $100.01 on the 320-acre farm. The differences in net returns were primarily due to differences in yields.

Snap beans (processed). Snap beans (processed) are planted in early May and mechanically harvested during the July-to-frost period.

The yields per acre were budgeted at 3 tons on the tribal enterprise farm and 2.5 tons on the individually operated farms. Gross returns per acre ranged from $295.50 on the tribal enterprise farm to $246.25 on the individually operated farms. Costs varied from a low of $182.00 on the 1280-acre farm to a high of $196.34 on the 320-acre farm. Cost per acre amounted to $189.80 on the tribal enterprise farm and $189.14 on the 640-acre farm. The differences in costs were due primarily to different

efficiencies in machine use. Custom harvesting on the individually operated farms was slightly higher than noncustom harvesting costs on the tribal enterprise farm budget. A supervision and management charge of $43.42 per acre on the tribal enterprise farm more than offset the $20 per acre land charge on the individually operated farms.

Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms ranged from $105.70 per acre on the tribal enterprise farm to $69.91 on the 320-acre farm. The differences in net returns were primarily due to differences in yields.

Sweet potatoes. Sweet potatoes are transplanted as slips in early May and mechanically harvested from mid-September to mid-October.

The yields per acre were budgeted at 7.0 tons on the tribal enterprise farm and 6.25 tons on the individually operated farms. Gross returns per acre ranged from $308.00 on the tribal enterprise farm to $275.00 on the individually operated farms. Costs per acre varied from a high on the tribal enterprise farm of $265.35 to a low of $227.10 on the 1280-acre farm. The differences in costs were due primarily to the supervision and management charges of $81.23 per acre on the tribal enterprise farm and the lower machinery efficiency of the individual farms. Net returns to land and capital on the tribal enterprise farm, and to land, capital, and management on the individually operated farms ranged from $42.65 per acre on the tribal enterprise farm to $67.90 on the 1280-acre farm. The differences in net returns were mainly due to lower costs of production on the individually operated farms.

Orchard Crops

One orchard crop, apples, was considered as a possibility for the Navajo Indian Irrigation Project under the tribal enterprise farm. Apple budgets were not constructed for the individually operated farms. The budgets were based on planting semi-dwarf varieties, spaced 9 by 18 feet (268 trees per acre), in early spring. The orchard should start light production in the fourth year and reach full production in the eleventh year. Life of the orchard was assumed to be 25 years. The establishment costs for the first seven years were compounded at seven percent for seven years because of the required seven years before the orchard begins to return an annual profit. The seven year establishment cost was prorated over the productive life of the orchard.

The yield was assumed to be 800 boxes on the average from the eighth through the twenty-fifth year. The average gross return was budgeted at $2,136 with total costs of $2,094, leaving a net return to capital and land of $41.86 per acre.

Vegetable Cannery

The Navajo Indian Irrigation Project offers an opportunity for the establishment of a vegetable processing facility (cannery) due to the following favorable factors:

1. Low delivered raw product costs;
2. Surplus labor area;
3. Sandy loam soils and absolute moisture control through irrigation, plus relatively stable and predictable climate, permitting--

a) Freedom in critical planting and harvest times, which will stabilize raw product flow and minimize plant capital investment; nominal extra productive capacity for input surges and nominal idle productive capacity for input lulls;

b) Maximum utilization of expensive field mechanical harvesting equipment;

c) Better quality control through moisture control and harvest timing, thereby maximizing selling price;

4. Excellent water availability for processing;

5. A continuing increase in the migration trend to the southwestern United States, thereby expanding near-by finished product markets;

6. Advantageous tax rates;

7. Minimum urban encroachment;

8. Practicality of developing a product mix which will:

a) Lessen finished product market price risks which are inherent in a one-commodity cannery operation;

b) Lower in-plant overhead by permitting a long operating season;

c) Afford opportunities for the development of both high-value, low-volume and low-value, high-volume complementary products.

The two primary negative factors are: first, transportation costs of manufactured supplies in and finished product out; and second, properly trained personnel.

The potential advantages should outweigh the expected disadvantages. Furthermore, proper planning and implementation of the transportation factor and adequately coordinated education and training of plant personnel will minimize both negative factors.

Preliminary estimates, based on 1970 building and equipment costs, show an expected investment capital requirement of $1,609,108 for a single multi-product plant (table 11). This figure does not include the cost of land, water supply system, and architectural and engineering fees. The budgeted plant has a raw product input capacity varying between 10,000-15,000 pounds per hour. It is estimated that the total annual pack will be approximately 1,100,000 cases (basis: 24/303) which will be produced from a total raw product input of 24,500,000 pounds or 6,176 acres of vegetables on the individually operated farms, or 5,192 acres of vegetables on the tribal enterprise farm. Raw product input requirement is reported in table 12.

The first year, gross operating capital requirement was estimated at $3,450,925. Cash flow was not taken into consideration in this estimate because product carry-over data could not be determined. Had more data been developed and applied, the above figure would probably have been substantially less. Neither of the capital requirements include interest costs.

Finished product prices used in developing net operating profit were the 1968-1970 United States average spot f.o.b. cannery prices on each item packed.

Using 1970 United States average grower-canner contract prices for raw product cost (tables 7-10), the net operating profit was estimated at $400,254 annual basis before interest charges (table 13).

Using Navajo Indian Irrigation Project direct production costs for raw product input prices (tables 7-10), the net operating profit estimate is $907,466 annual basis before interest charges (table 11).

Employment potential for the single unit cannery, exclusive of administrative personnel, varies seasonally from a low of 60 to a high of 210,

Table 11. Capital investments for a one unit cannery enterprise, Navajo Indian Irrigation Project

	. . . . . dollars		
Plant and warehouse (pre-fab steel)	513,460		
Standpipe and auto sprinkler system	65,000		
Waste water system	44,000		
Total Building Costs			622,460
Preparation Equipment			
Root crops (3)	88,300		
Pickles	69,500		
Sauerkraut	43,300		
Asparagus	66,570		
Green beans	92,760		
Sweet potato	21,500		
Total Specific Line Costs		385,930	
Total Common Line Equipment Costs		344,920	
Total Equipment Costs			730,850
Equipment installation and transportation costs	146,170		
Miscellaneous equipment costs[1]	109,628		
			255,798
Total Investment			1,609,108

1 Miscellaneous equipment: lug boxes, storage hopper, flumes, empty can crates, shop and lab equipment, office equipment, plus other contingencies.

Table 12. Raw product requirements for vegetable processing plant, Navajo Indian Irrigation Project

Vegetable	Quantity
	pounds
Asparagus	4,500,000
Sweet potatoes	4,000,000
Carrots	3,000,000
Cabbage	2,200,000
Green beans	4,000,000
Beets	1,800,000
Cucumbers	2,000,000
White potatoes[1]	3,000,000
Total	24,500,000

1 Cull potatoes from the fresh pack will be used in the vegetable processing plant.

Table 13. Estimated annual income statement for a one unit cannery enterprise, Navajo Indian Irrigation Project

	. . . . . .dollars.	
Sales		
Asparagus (172,500 cs)	1,345,845	
Sweet potatoes (150,000 cs)	572,250	
Carrots (97,500 cs)	261,738	
Sauerkraut (59,400 cs)	209,088	
White potato (112,500 cs)	324,000	
Green bean (250,000 cs)	827,750	
Beets (63,000 cs)	162,245	
Pickles (320,000 gal)	353,940	
Total sales		4,056,856
Expenses		
Overhead		
Insurance		
Inventory	13,996	
Workmens Compensation	15,598	
Liability	2,165	
Buildings	3,543	
Equipment	5,043	
	40,345	
Repairs		
Physical Plant	7,701	
Equipment maintenance	50,566	
	58,267	
Depreciation		
Plant and warehouse	25,673	
Equipment	91,356	
	117,029	
Total overhead expenses		215,641
Operating		
Raw product	1,301,930	
Cans	1,041,897	
Cases	80,949	
Indirect supplies	78,068	
Fuel	17,990	
Power	15,564	
Water	16,185	
Direct labor	555,120	
Specific selling cost	222,857	
Administrative	110,400	
Total operating expense		3,440,960
Total expenses		3,656,601
Net operating profit		400,255

depending on the product being canned. Total annual man hours of direct labor were estimated to be 221,000 hours.

Number of employees of skill levels and respective wage rates for the canning plant (not including field production and harvesting) are shown in table 14.

The packing season would begin approximately the first of May, with double shifts in July, August, and September, and end with the processing of sauerkraut and pickles during January and February.

LIVESTOCK

Feedgrains and roughages are likely to be important crops on the Irrigation Project lands because of suitable climatic conditions. These crops are essential to livestock production. An ample supply of roughages and/or feedgrains would facilitate the establishment of various livestock businesses and would thereby create employment and income opportunities for the Navajo Tribe. The establishment of sizable livestock enterprises would,in turn,create a large local market for feedgrains and roughages.

The types and sizes of livestock businesses considered are shown in table 15. Each has the potential of being a profitable operation. Broiler production and processing also appears feasible for the Navajo Indian Irrigation Project, but was not investigated sufficiently for inclusion in this report as an alternative.

Information on investment capital requirements, operating capital needs, annual income and expenses, and labor requirements by level of skills were developed for each of the livestock activities listed in table 15. This information is summarized in this section. An annual interest charge

Table 14. Labor needs, wage rates, weekly man-hour requirements, and monthly wages for a one-unit vegetable cannery, Navajo Indian Irrigation Project

Position	Number Employed	Monthly Wage Rate	Total Wages Monthly	Man-hours Weekly
General manager	1	$2,000	$ 2,000	48
Sales manager	1	1,440	1,440	40
Accountant	1	960	960	48
Secretary	1	480	480	40
Lab technician	1	480	480	55
Time keeper	1	480	480	55
Plant superintendent	1	960	960	55
Assistant plant superintendent	1	720	720	55
Field superintendent	1	960	960	55
Assistant field superintendent	1	720	720	55
Line foremen	5	600	3,000	275
Field foremen	5	600	3,000	275
Maintenance men	12	480	5,760	600
Fork lift operators	5	480	2,400	250
Closing machine operators	5	480	2,400	250
General labor[1]	126	355	44,730 [1]	5,040
Total	168		$70,490	7,196

1 Average employment for 8 months only packing season.

Table 15. Types and sizes of livestock businesses for which budgets were developed, Navajo Indian Irrigation Project

Livestock Type	Unit Size
Egg	300,000 layers
Dairy	1,104 cows
Swine	25 sow
	50 sow
	100 sow
	600 sow
Backgrounding feedlot	100 head capacity
	500 head capacity
	1,000 head capacity
	5,000 head capacity
Feedlot	15,000 head capacity
	Units per Acre
Yearling, summer grazing	4 steers
Cow-Calf	.9 animal units

on the invested capital and operating capital was not included as an expense item in any of the livestock budgets. The return figure used was net operating profit, which is a measure of the net return to the total assets employed.

A charge for management was included in all livestock activities budgeted as alternatives for the tribal enterprise farm. A management charge was not included in the budgets developed as alternatives for the individually operated farms. It was assumed that the farm operator would provide the necessary management. Hence, the net operating profit estimates for these budgets are measures of return to total assets and management.

Land rental and property taxes were not included as expense items. The tribal lands are not subject to property taxes. The crop budgets for the individually operated farms included a land rental charge of $20 per acre. However, with the exception of cattle on irrigated pasture, the livestock activities budgeted required very little land, so this charge was omitted.

Dairy

A 1,104-cow dairy operation was budgeted as an alternative for the tribal enterprise farm for the Navajo Indian Irrigation Project. Approximately 300 cows are required to achieve sufficient economies of size in equipment utilization and management. Recent studies indicate 1,004-cow operations achieve most of the economies, and per-unit production costs decline very little, if any, above 1,000 cows. The 1,104-cow operation was selected on the basis of production efficiency and available market

outlets. A larger sized dairy operation could be efficient, but it was determined that the increased production resulting from expansion beyond 1,104 cows could not be marketed at a profitable price.

The following assumptions were made in the development of the dairy budget:

1. Dairy cattle are purchased as springing heifers.
2. Operating expenses are based on a 45-pound production per cow per day, with one percent of the total unmarketable due to typical dairy herd health problems.
3. Dairy herd culling rate was 33 percent annually.
4. A 90-percent calf crop was assumed, with one percent of these lost within the first week. A 50:50 heifer - bull calf ratio was assumed.
5. The number of heifers retained as replacements was based on the herd culling rate plus two percent for heifer death loss and two percent for milking herd death loss.
6. Milk was assumed to be marketed through a milk marketing cooperative in the area by purchasing a producer marketing base at $720 per cow. A blended average price of $6 per hundredweight was assumed.
7. All wages paid to employees, except supervisory and clerical, were calculated at $2.22 or $3.00 per hour depending upon skill level.
8. Annual production expenses including medication, veterinary, breeding, and supplies were calculated at $35.00 per cow, $12.00 per springing heifer, and $4.00 per heifer. Fuel and utilities

were calculated at $13.00 per cow annually. These costs, which do not include feed, are based on expenses incurred by typical operations of comparable size.

9. Feed prices used were $1.29 per bushel for corn, $27.91 per ton for alfalfa hay, and $7.50 per ton for corn silage. A 13-percent shrink and loss factor was used for hay and 25-percent factor for silage. Hence, the cost per ton fed of these ingredients were thereby increased by 13 and 25 percent, respectively.
10. Depreciation was calculated using the straight-line method. Physical improvements (buildings, corrals, silage pit) were depreciated over 20 years with no salvage value. Milking equipment was depreciated over 15 years with 10-percent salvage value. Machinery was depreciated over 10 years with 10-percent salvage value.
11. Annual repair costs were estimated as a percentage of original investment. Repairs for physical improvements were based on three percent of original investment, while repairs for equipment and machinery were calculated at eight percent of original investment.
12. Insurance for alfalfa hay, employee health, liability, vehicles, buildings, and equipment was based on current rates.

Estimated income, expenses, and net operating profit for the 1,104-cow dairy are shown in table 16. It is anticipated that the dairy operation would return a net operating profit (before interest and income taxes) of approximately $183,000 annually. This profit estimate is based on annual sales of approximately $945,000 and annual expenses of $762,000.

Major expense items are roughage and concentrate feeds and labor. Feed expenses, most of which could be produced on the project lands, amount to

Table 16. Estimated annual income statement for a 1,104-cow dairy enterprise, Navajo Indian Irrigation Project

		.....dollars.....	
Sales			
Milk (141,912 cwt. at $6)		851,472	
Cull cows (364 at $200)		72,800	
Calves (600 at $35)		21,000	
Total Sales			945,272
Expenses			
Overhead			
Insurance			
Hay	4,676		
Health	2,160		
Liability	1,440		
Vehicle	500		
Buildings	1,804		
Stationary equipment	1,000		
Movable equipment	320		
	11,900		
Repairs			
Physical improvements	6,648		
Dairy equipment	7,314		
Machinery	5,106		
	19,068		
Depreciation			
Physical improvements	11,080		
Dairy equipment	5,485		
Machinery	5,744		
	22,309		
Total Overhead Expense		53,277	
Direct operating			
Roughage	237,187		
Concentrates	178,327		
Utilities and power	14,352		
General production	44,700		
Labor	163,800		
Mixing feed at $4 per ton	13,882		
Milk hauling at $.40 per cwt.	56,765		
Total Operating Expense		709,013	
Total Expenses			762,290
Net Operating Profit			182,982

nearly 55 percent of total expenses. Major feed ingredients are alfalfa hay, corn silage, and corn or grain sorghum.

The annual total labor expense of $163,200 is slightly more than 20 percent of total expenses. A listing of the types of labor, weekly man-hour requirements, and wage rates is presented in table 17. It is anticipated that a 1,104-cow dairy would employ 24 persons on a full time year-round basis.

Investments required to establish a 1,104-cow dairy are listed in table 18. Total capital investment needs were estimated to be $1,668,528. The purchase of a producer marketing base of $720 per cow is the largest capital item. This $794,880 investment is needed before milk can be sold to the milk marketing cooperative. The base would not be required if the dairy performed its own processing and distributing. However, this alternative is difficult and risky and is not a guaranteed market.

The purchase of milking cows at $450 each is the next largest investment item. Investment in buildings, equipment, and machinery is estimated to be nearly $377,000.

Egg Production

The Four Corners Region and New Mexico in particular are a deficit egg production area. A sizable number of eggs are shipped into New Mexico from California. California producers have traditionally used the Southern Rocky Mountain area including New Mexico as a market for surplus production. However, California egg producers ship in most of their feedgrains from the High Plains and Mid-West. Because of the high feedgrain costs to California producers, an egg production unit on the Navajo Indian Irrigation Project

Table 17. Labor needs, wage rates, weekly man-hour requirements, and monthly wages for a 1,104-cow dairy, Navajo Indian Irrigation Project

Position	Number Employed	Monthly Wage Rate per worker	Total Wages monthly	Total Man-Hours per week
Manager	1	$1,000	$1,000	60
Herdsman	1	700	700	60
Foreman	2	600	1,200	120
Secretary	2	350	700	96
Maintenance	2	500	1,000	108
Milkers	6	675	4,050	336
Feeders	3	500	1,500	168
Calfman	1	500	500	56
Utility men	6	500	3,000	336
Totals	24		$13,650	1,340

Table 18. Capital investment by item for a 1,104-cow dairy business, Navajo Indian Irrigation Project

	. . . . . dollars	
Dairy cows at $450		496,800
Corrals[1]	66,240	
Milking plant and equipment	130,000	
Heifer setup[2]	20,000	
Hay and hospital barns	60,720	
Silage pit	10,638	
Miscellaneous[3]	25,425	
		313,023
Machinery		
Pickup trucks	13,200	
Utility truck	6,000	
Tractors	29,800	
Wagons	8,400	
Other machinery[4]	6,425	
		63,825
Marketing base[5]		794,880
Total		1,668,528

1 Includes water system, shade, and stanchion.
2 Includes maternity barn and corrals.
3 Miscellaneous - Truck scales, loading chute, office equipment, generator.
4 Other machinery - Sprayers, hand tools, silage equipment, front-end loader, welding equipment.
5 Base calculated at $720 per cow.

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lands should be able to competitively market eggs in the northern New Mexico and southern Colorado market areas. A production unit on the project lands would have cost advantages over California producers through locally produced feedgrain and proximity to the Northern New Mexico and Southern Colorado market areas.

The majority of eggs produced in the Western United States are from operations having 300,000 layers or more. These operations grade and package eggs in retail cartons requiring no further processing. Most of the efficient packaging and processing equipment is designed to handle the annual output from 300,000 layers.

A 300,000-layer egg operation was budgeted as an alternative for the tribal enterprise farm on the Navajo Indian Irrigation Project. It was estimated that the Northern New Mexico and Southern Colorado market area could absorb the output from this size of operation without depressing prices below profitable level. The assumptions used in the egg budget were as follows:

1. The egg enterprise would consist of 300,000 layers in a completely automated cage system with controlled environment. Eggs would be produced and processed at the same location. Eggs will be cartoned and ready for retail sale. The average price received was estimated at $.40 per dozen.
2. Layers produce 240 eggs annually per hen housed, and 92 percent of these eggs are salable. Total salable production is 5,520,000 dozen or 184,000 cases annually.
3. Layers are replaced after one year of production on an all-in, all-out basis. The price received for cull hens was $.20 per

bird. The mortality rate was calculated at 15 percent per year, hence only 255,000 cull birds are sold annually.

4. Utilities and supplies include telephone, office equipment, office supplies, sanitation equipment, sanitizers, vaccines, and medication and are estimated at $.10 per bird annually.
5. Feed consumption was estimated at 3.8 pounds per dozen eggs produced. Feed ingredient costs were based on current prices for feedstuffs purchased off the project. Corn was priced at $1.29 per bushel. Feed mixing facilities were not included in the budget. It is anticipated that one feedmill on the project will be utilized for milling all livestock feed. A milling charge of $4.00 per ton is included in the feed cost.
6. Expenses listed included all production and processing (packing) expenses including egg cartons and cases. Transportation expenses for moving the cartoned eggs to the retail stores are not included.
7. Taxes and interest expenses are not included.
8. Depreciation was calculated using the straight-line method. Buildings were assumed to have a 20-year life and equipment an 8-year life.
9. Annual repair and maintenance costs were estimated at 1 percent of original costs for buildings and at 2½ percent for equipment.

A projected annual income statement for the 300,000-layer operation is presented in table 19. It is expected that the egg operation will return a net operating profit (profit before interest and income taxes) of $526,210 on annual sales of $2,259,000. Annual total expenses are estimated to amount to $1,732,790 or 31.39 cents per dozen sold.

Table 19. Projected annual income statement for a 300,000-layer egg production and processing operation, Navajo Indian Irrigation Project

		Total	Per Dozen[1]
	dollars	dollars	cents
Sales			
Eggs (5,520,000 dozen at $.40)		2,208,000	40.00
Cull birds		51,000	.92
Gross Receipts		2,259,000	40.92
Expenses			
Overhead			
Depreciation			
Building	26,650		
Equipment	90,875		
Total Depreciation		117,525	2.13
Insurance			
Buildings and equipment		15,750	.29
Repairs and maintenance			
Buildings	5,330		
Equipment	18,175		
Total Repairs and Maintenance		23,505	.42
Total Overhead		156,780	2.84
Direct Operating Expense			
Pullets		480,000	8.70
Feedstuffs (11,400 tons at $59.65)		680,010	12.32
Supplies and utilities		30,000	.54
Processing supplies ($1.25 per case)		230,000	4.16
Labor		156,000	2.83
Total Direct Operating Expense		1,576,010	28.55
Total Expenses		1,732,790	31.39
Net Operating Profit		526,210	9.53

1 Based on 5,520,000 dozen salable eggs or 92 percent of total production.

Production and processing expenses are separated in table 20. Production expenses are estimated at 24.99 cents per dozen sold and processing expenses are 6.40 cents per dozen sold.

The egg operation is expected to provide full time employment for 28 individuals. A listing of labor needs, man-hour requirements, and wage rates is shown in table 21.

The major investment items for a 300,000-layer operation are summarized in table 22. The egg operation is projected to require a total investment of $1,740,000 or $5.80 per bird. Investment in buildings and equipment is projected at $4.20 per bird. The initial laying flock is expected to cost $1.60 per bird.

Approximately $180,000 would be required for operating capital to establish a 300,000-bird egg enterprise. This operating capital requirement is based on the assumption that the enterprise would start production with 30,000 layers and increase the flock size by 30,000 layers per month for 10 months.

Swine Production

The Southwest and in particular the Four Corners Region are pork deficit areas, producing less than 25 percent of total consumption needs. The majority of pork in the area is shipped in from the surplus producing areas of the Great Plains and Midwest. The Navajo Indian Irrigation Project area has a slight advantage in pork prices compared to Midwest producers because of the generally rising price level between the surplus Midwest and deficit Southwest. This rising price level is associated with transportation costs of moving pork carcasses.

Table 20. Itemization of annual production and processing expenses for a 300,000-layer egg operation, Navajo Indian Irrigation Project

	Production Expense		Per Dozen	Processing Expense		Per Dozen
	. . . dollars. . .		cents	. . dollars. . .		cents
Overhead						
Depreciation						
Buildings	23,400			3,250		
Equipment	78,375			12,500		
Total Depreciation		101,775	1.84		15,750	.28
Insurance						
Buildings and equipment		13,688	.25		2,062	.04
Repairs and Maintenance						
Buildings	4,680			650		
Equipment	15,675			2,500		
Total Repairs and Maintenance		20,355	.37		3,150	.06
Total Overhead		135,818	2.46		20,962	.38
Direct Operating Expense						
Pullets		480,000	8.70			
Feed		680,010	12.32			
Supplies and utilities		15,000	.27		15,000	.27
Processing supplies					230,000	4.16
Labor						
Production	38,400		.69			
Processing				57,600		1.04
Maintenance	9,720		.18	9,720		.18
Watchmen	4,800		.09	4,800		.09
Secretary	2,520		.05	2,520		.05
Administration	12,960		.23	12,960		.23
Total Labor		68,400	1.24		87,600	1.59
Total Direct Operating		1,243,410	22.53		332,600	6.02
Total Expenses		1,379,228	24.99		353,562	6.40

Table 21. Labor needs, wage rates, weekly man-hour requirements, and monthly wages for a 300,000-layer egg operation, Navajo Indian Irrigation Project

Position	Number Employed	Monthly Wage Rate Per Worker	Total Monthly Wages	Total Per Week Man-Hours
		. . . . . dollars.		
Manager	1	1,440	1,440	60
Supervisor	1	720	720	45
Production	8	400	3,200	360
Processing	12	400	4,800	540
Maintenance	3	540	1,620	135
Watchman	2	400	800	90
Secretary	1	420	420	40
Totals	28		13,000	1,270

Table 22. Investments in buildings, equipment, and birds for a 300,000-layer egg operation, Navajo Indian Irrigation Project

	. . . . . dollars. . . .
Buildings	
Hen houses ($1.55 per bird)	465,000
Processing building[1]	65,000
Generator building	3,000
	533,000
Equipment	
Hen houses ($2.00 per bird)	600,000
Processing equipment[2]	100,000
Standby generator (450 kw)	27,000
	727,000
Total Investment in Buildings and Equipment	1,260,000
Poultry	
300,000 at $1.60	480,000
Total Initial Investment	1,740,000
Investment in Building and Equipment per Bird	4.20
Initial Total Investment per Bird	5.80

1 Includes refrigeration unit.
2 Includes blood spot detector and packaging equipment.

The Irrigation Project area has favorable climatic conditions for hog production. The dry mild climate would allow less elaborate facilities and present fewer disease problems than found in the more humid Midwest.

Swine production units can be designed for many different situations of labor, feed, and capital availability. Efficient swine units can range in size from 25 sows to over 600 sows. Operations having less than 25 sows can not effectively utilize specialized equipment such as farrowing crates and feed handling equipment and are not able to obtain labor efficiencies. Risks of serious disease outbreaks make it advisable to consider building completely separate units rather than expanding one unit much beyond 600 sows.

Swine operations of 25 to 50 sows offer an opportunity for farmers to market feedgrains through fed hogs and to utilize surplus labor. Swine operations of 100 sows completely utilize one man's labor and cannot be regarded as supplemental businesses to farming.

Investment, cost, and return budgets were developed for swine production units of 25 sows, 50 sows, 100 sows, and 600 sows. The 25-sow unit was developed as a production alternative for 320-acre farms. The 50-sow unit and the 100-sow unit were budgeted as alternatives for 640-acre and 1280-acre farms, respectively. The 600-sow unit was budgeted as an alternative for the tribal enterprise farm. Assumptions for the budgets are as follows:[2]

1. An average of 16.0 pigs raised per producing sow per year.

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2 For more detailed assumptions, budgets, and producting guidelines see "Costs and Returns to Various Sizes and Types of Swine Operations in the Four Corners Region", Report to Four Corners Commission, New Mexico Agricultural Experiment Station Research Report in process by L. A. Brown and W. D. Gorman.

2. An average of 10-percent nonproducing sows on a year-round basis, such as slow breeders, nonbreeders, etc.
3. Each producing sow raises an average of approximately 7.2 pigs per litter and has an average of 2.3 litters per year.
4. One third of the sow herd is replaced each year.
5. One boar is maintained for each 25 sows.
6. Hogs are sold at either Albuquerque, New Mexico, or Phoenix, Arizona at an average price of $22.00 per hundredweight for market pigs and $18.05 per hundredweight for cull animals.
7. The 25-, 50-, 100-, and 600-sow units produce 81,800, 162,800, 325,850, and 1,956,300 pounds of total pork per year. Approximately five percent of the total pounds produced are cull animals, but this figure varies slightly with the various size units.
8. The overall feed conversion ratio was 4:1. (Total pounds of feed consumed compared to total pounds of pork produced.)
9. A corn cost of $1.20 per bushel was used for the 25-, 50-, and 100-sow units and a cost of $1.29 per bushel was used for the 600-sow unit.
10. Mixing, storing, and delivering rations cost $4.00 per ton.
11. Depreciation was based on the straight-line method over a 15-year period.
12. Repairs and maintenance and overhead cost estimates were based on actual figures obtained from surveying similar sized units (2).

13. A semi-confinement system was budgeted for all sizes but the amount of specialized buildings and equipment per sow unit increased as the size of the unit increased.

The 25-sow unit is budgeted to return $670 annual net operating profit on annual sales of $17,810 and $2,720 in annual labor income to the farm operator (table 23). The 50-sow unit has an annual net operating profit of $1,400 (table 23). Profit from the 50-sow unit was slightly greater than twice the profit expected from the 25-sow unit due to economies of size in facilities and labor expenses. The 100-sow unit is expected to generate $3,985 in annual net operating profit (table 23). A total of $17,900 in net operating profit is expected from the 600-sow unit.

Feed is the largest expense item for all swine production units, amounting to about two-thirds of the total expenses. Corn was the principal feed ingredient budgeted and was charged to the swine operation at $1.20 per bushel for the 25-, 50-, and 100-sow units, and $1.29 per bushel for the 600-sow unit. These cost figures were used because the 320-, 640-, and 1280-acre farm sizes were assumed to sell corn at $1.20 per bushel. The tribal enterprise farm was assumed to sell corn at $1.29 per bushel. The higher corn price budgeted for the tribal enterprise operation is based on the assumption that additional services and larger quantities will be offered for sale commanding higher prices.

Investment in equipment, facilities, and livestock varies from $8,340 for the 25-sow unit to $370,380 for the 600-sow unit (table 24). The units become more capital intensive and less labor intensive with increased size. The 600-sow unit is designed to utilize highly specialized equipment

Table 23. Projected annual income statements for 25-, 50-, 100-, and 600-sow swine production units, Navajo Indian Irrigation Project

Item	Sows			
	25 Head	50 Head	100 Head	600 Head
	. . . . . dollars			
Sales				
Market hogs	16,940	33,880	67,760	407,530
Cull animals	870	1,600	3,240	18,750
Total	17,810	35,480	71,000	426,280
Expense				
Feed	11,210	22,335	44,645	278,310
Custom feed processing	595	1,185	2,370	13,880
Medical and supplies	365	990	1,860	8,410
Labor	2,720	4,620	9,045	49,590
Manager	--	--	--	14,880
Replacement boars	100	300	600	3,900
Vehicle and equipment	350	700	1,240	5,340
Repairs, maintenance, miscellaneous	350	700	1,135	6,400
Depreciation	700	1,650	2,870	20,810
Marketing	800	1,600	3,250	6,860
Total	17,190	34,080	67,015	408,380
Net Operating Profit	670	1,400	3,985	17,900

Table 24. Capital investments in facilities, equipment, and livestock for 25-, 50-, 100-, and 600-sow swine production units, Navajo Indian Irrigation Project

Item	Sows			
	25 Head	50 Head	100 Head	600 Head
	. . . . . dollars.			
Facilities and equipment				
Farrowing	900	3,800	6,585	63,000
Nursery	350	2,850	5,700	54,000
Finishing	1,875	4,955	9,910	110,530
Gestation and other pens	750	1,810	3,150	18,550
Feed storage	200	200	400	3,000
Feed processing and delivery		1,500	1,500	3,000
Water system	300	1,000	1,500	6,500
Waste disposal system	200	500	750	7,000
Other utilities				4,300
Office				5,600
Transportation and hauling	865	1,600	2,100	9,400
Miscellaneous		100	200	13,500
Total	5,440	18,315	31,795	298,380
Livestock				
Sows	2,500	5,000	10,000	60,000
Boars	400	600	1,200	12,000
Total livestock	2,900	5,600	11,200	72,000
Total investment	8,340	23,915	42,995	370,380

and a relatively few well-trained individuals. The 25-sow unit is designed to utilize surplus farm operator labor with a minimum investment in facilities and equipment. The 50- and 100-sow units are between these two extremes.

The 25-sow unit will require about 23 hours of general labor per week (table 25). This amounts to approximately half-time employment for a farm operator. The 50-sow unit requires about 44 hours of labor per week. Approximately 65 hours of labor per week is needed to operate a 100-sow unit. A 100-sow unit could be operated by one man working about 10 hours per day but would leave very little time available for other farming activities. Hence, it is anticipated that the 100-sow unit would involve one nearly full-time employee with the farm operator occupied only part-time. The 600-sow unit will require a total of eight employees consisting of a manager, foreman, two herdsmen, a secretary-bookkeeper, and three general laborers (table 25).

Annual operating capital requirements for 25-, 50-, 100-, and 600-size units were estimated at $635, $11,600, $20,560, and $141,305, respectively.

Backgrounding Feedlots[3]

Backgrounding is a method of growing out calves from the time they are weaned until they are ready for a finish feedlot. During backgrounding, animals are kept in feedlots and fed a growing ration of harvested roughages

3 For more detailed information on backgrounding feedlots see "Economic Potential of Backgrounding Feeder Calves in Southeastern New Mexico," by William N. Capener, William D. Gorman, and Palmer J. McCarter, Agricultural Experiment Station Research Report 193, New Mexico State University, March 1971.

Table 25. Labor needs, wage rates, weekly man-hour requirements, and monthly wages for 25-, 50-, 100-, and 600-sow swine production units, Navajo Indian Irrigation Project

Size of Unit	Position	Number Employed	Total Monthly Wages	Weekly Labor Requirements
			dollars per individual	man-hours
25 Sow	General laborer	1	225	23
50 Sow	General laborer or operator	1	385	44
100 Sow	Operator	1	270	15
	General laborer	1	480	50
600 Sow	Manager	1	1,240	60
	Foreman	1	920	55
	Herdsmen	2	820	45
	Secretary-Bookkeeper	1	420	40
	General laborers	3	385	44

with a small amount of grain. Calves are generally placed in backgrounding lots for a four- to five-month period.

Costs of gains generally are higher for backgrounding in feedlots than for calves on pasture, but recent late fall and winter price relationships have been favorable for profitable backgrounding in confinement lots. If prices of feed, calves, yearling feeders and other costs maintain relationships in the future similar to those in recent years, feeding calves in backgrounding lots has the potential of being a profitable enterprise for the Navajo Indian Irrigation Project.

The trend in cattle prices in recent years from a seasonal low in the fall to a seasonal high in the late winter to early spring is the most significant factor affecting the profit opportunities from backgrounding lots. Background lot operators who purchase feeder calves in the fall and sell yearling feeders in the late winter and early spring generally buy calves at the seasonal low price and sell feeders during the seasonal high price period. Price relationships are such that it is profitable to feed only one group of calves each year.

Budgets were developed for 100-, 500-, and 1,000-, and 5,000-head backgrounding feedlots. It was assumed that the 100-head lot would be a supplemental business to the 320-acre farms. The 500-head and 1,000-head lots were developed as supplemental businesses to the 640- and 1280-acre farms. The 5,000-head lot was budgeted as an alternative business for the tribal enterprise farm.

Backgrounding lots are very similar to finish feedlots. The primary difference in facilities between the two kinds of feedlots is that the finish feedlot has a complete feed mill with automated feed handling equipment.

Since backgrounding lots are expected to remain idle nearly seven months per year, the one group of calves fed per year will have to cover the annual overhead costs. Hence, for profitable operation it is necessary to keep the facilities investment per head as low as possible.

Assumptions used in developing the backgrounding feedlot budgets were as follows:

1. Approximately 200 square feet of pen space per animal and an assortment of pens of 100- and 200-head capacities.
2. Fencing materials used for the 100-head capacity feedlot were railroad cross ties or cedar posts at $2.00 each, on eight-foot centers, and five strands of half-inch used oil field cable at $.05 per foot. Estimated fencing costs included labor at $1.00 per running foot for the 100-head capacity feedlot.
3. Fencing material used for the 500-head, 1,000-head, and 5,000-head lots were:
   a) Three-inch used metal pipe posts set in concrete on eight-foot centers with a concrete collar ten inches above the ground.
   b) A three-inch metal pipe connecting the top of the posts and another pipe installed midway between the top of the posts and the ground.
   c) Two strands of half-inch used metal cable stretched above and two below the mid-rail pipe.

   The cost of this type of fencing installed was established at approximately $2.00 per running foot.
4. Fourteen-foot gates at $25.00 each.

5. Feedbunks: 18 inches of feedbunk space per head capacity.

   a) For the 100-head capacity lot, 2" x 10" rough lumber with a 2-foot wide concrete floor and 6-foot wide concrete apron. Feedbunk cost with apron and fence above the bunk including labor $3.20 per running foot.

   b) For the 500-, 1,000-, and 5,000-head capacity feedlots, formed concrete with an 8-foot apron and a pipe and cable fence above the feedbunk. Estimated cost including labor was $5.00 per running foot.

6. Grain storage tanks and 6-inch auger: 5-ton capacity for the 100-head lot, 30-ton capacity for the 500-head lot, 60-ton capacity for the 1,000-head lot, and 120-ton capacity for the 5,000-head lot. Pit silage storage was estimated to cost $.15 per ton of capacity to construct.

7. Platform scale: 8' x 16', 10-ton limit for cattle and small vehicles for the 500-head capacity lot; 10' x 34', 20-ton limit for cattle and trucks and the tractor-trailer feed wagons for the 1,000- and 5,000-head capacity lots. No scales were budgeted for the 100-head lot.

8. Prices for calves purchased and feeders sold were based on 3-year average monthly quotations for Choice grade 300-550 pound calves, October through December, 1967-1969, and Choice grade 550-750 pound feeders, February through April, 1968-1970 at Clovis, New Mexico.

9. Ration consists of corn grain, corn silage, alfalfa hay and salt-mineral premix. Corn grain costs $1.20 per bushel for the 100-,

500-, and 1,000-head lots and $1.29 per bushel for the 5,000-head lots. Corn silage costs $10.00 per ton out-of-the-pit. This corresponds to a price of $7.50 per ton going into the pit allowing a 25-percent shrink and spoilage loss. Alfalfa hay (baled) costs $32.00 per ton out of the stack. This corresponds to a price of about $28.00 per ton into the stack allowing for a 12-15 percent loss.

10. Death loss was estimated at 1.5 percent annually.
11. Costs of purchasing and maintaining tractors are shared with the farming activities for the 100-, 500-, and 1,000-head lots.

The 100-head lot budget indicates an annual operating profit of $567 (table 26). The 100-head lot also provides the operator an opportunity to earn $710 in labor income and to sell 29 tons of corn, 107 tons of corn silage, and 21 tons of alfalfa hay. The net operating profit increases to $4,572 for the 500-head lot and $10,458 for the 1,000-head lot (table 26). The 5,000-head lot is expected to return $56,090 in annual net operating profit.

Feed is the single largest cost item ranging from 60 percent of total costs for the 100-head lot to 69 percent for the 5,000-head lot. Labor costs per head of capacity decrease significantly as size increases ranging from 13.2 percent of total costs for the 100-head lot to 7.8 percent for the 5,000-head capacity. It was assumed that management for the three smaller sized lots would be provided by the farm operator. The 5,000-head lot is too large to operate as a sideline business, so, a $9,600 charge for management was included in the operating costs for the larger lot.

Table 26. Projected income statements for 100-, 500-, 1,000- and 5,000-head one-time capacity backgrounding feedlots, Navajo Indian Irrigation Project

Item	Feedlot Capacity			
	100 Head	500 Head	1,000 Head	5,000 Head
	. . . . . dollars			
Sales	16,555	82,775	165,550	827,750
Purchases	10,622	53,110	106,220	531,100
Gross margin	5,933	29,665	59,330	296,650
Expenses				
Feed	3,232	16,160	32,320	166,300
Labor	710	3,108	5,772	18,870
Death loss allowance	159	795	1,590	7,950
Fuel and utilities	335	1,675	3,350	16,750
Insurance	50	220	370	1,250
Depreciation	614	1,900	3,190	9,990
Veterinary and medicine	100	500	1,000	5,000
Repairs and maintenance	141	610	1,030	3,600
Miscellaneous	25	125	250	1,250
Management	-	-	-	9,600
Total	5,366	25,093	48,872	240,560
Net operating profit	567	4,572	10,458	56,090

Total investment in facilities and equipment ranges from $6,360 for the 100-head lot to $161,825 for the 5,000-head lot (table 27). Investment per head of capacity amounts to $63.60, $54.78, $46.30, and $32.37 for the 100-, 500-, 1,000-, and 5,000-head lots, respectively. The decrease in investment per head as size increases is attributed to greater utilization of facilities and equipment.

The 100-head lot requires 16 hours of labor per week for a 5-month period from November through March (table 28). The 500-head lots require about 70 hours of labor per week, and therefore will probably need two employees for effective operation. However, one individual willing to work long hours could operate a 500-head lot with only occasional assistance. The 1,000-head lot requires 3 full-time employees, and the 5,000-head lot provides employment for 10 people.

Backgrounding feedlots require substantial quantities of operating capital used mainly for cattle and feed purchases. Estimates of operating capital needs for the 100-, 500-, 1,000-, and 5,000-head lots are $14,920, $74,600, $149,200, and $746,000, respectively.

Beef Finish Feedlot

Important factors relating to the financial success of beef finishing feedlots are 1) adequate supply of feedgrains at competitive prices, 2) adequate supply of roughages such as corn silage, alfalfa, or sugar beet tops, 3) dry climate, and 4) beef slaughtering plants located preferably within 150 miles. It is anticipated that feedgrains and alfalfa will be major crops on the project lands, and therefore will provide a local supply source for a feedlot. Feedgrains can also be shipped into the

Table 27. Estimated investment in facilities and equipment for 100-, 500-, 1,000-, and 5,000-head backgrounding feedlots, Navajo Indian Irrigation Project

Item	Feedlot Capacity			
	100 Head	500 Head	1,000 Head	5,000 Head
	dollars			
Pens and equipment[1]	1,910	8,790	16,325	75,050
Water system	250	1,250	2,500	12,500
Feed storage and equipment	400	1,600	3,250	16,000
Feed distribution equipment	1,200	2,650	5,925	20,275
Tractor(s)	1,600	6,400	8,200	16,400
Manure equipment	900	900	1,600	1,600
Transportation equipment	0	1,500	2,500	5,000
Platform scale	0	4,000	5,500	5,500
Office and office equipment	0	0	0	7,000
Miscellaneous equipment[2]	100	300	500	2,500
Total investment	6,360	27,390	46,300	161,825
Investment per head capacity	63.60	54.78	46.30	32.37

1 Approximately 200-square f[illegible] of pen space per animal with pens of 100- and 200-head capacity

2 Estimated on the basis of $1 per head on the 100-head lot, 60 cents per head in the 500-head lot, and 50 cents per head for the 1,000-, and 5,000-head lots.

Source: Economic Potential of Backgrounding Feeder Calves in Southeastern New Mexico, Agricultural Experiment Station Research Report 193, 1971.

Table 28. Labor needs, wage rates, weekly man-hour requirements and monthly wages for 100-, 500-, 1,000-, and 5,000-head one-time capacity backgrounding feedlots, Navajo Indian Irrigation Project

Size of Unit	Position	Number Employed	Total Monthly Wages	Weekly Labor Requirements
			dollars per individual	man-hours
100 Head	General laborer	1	142[1]	16
500 Head	General laborer	1	266[1]	30
	Operator	1	355[1]	40
1,000 Head	General laborers	2	355[1]	40
	Operator	1	444[1]	50
5,000 Head	General laborers	9	373[1]	42
	Manager	1	800[2]	50

1 Employed five months per year from November through March.
2 Manager is employed year-round for a total annual salary of $9,600.

project area at competitive prices from the surplus grain producing areas of western Kansas, Texas, and Oklahoma. It is unlikely that roughages would be shipped into the region because of expected surplus production on the project lands.

Wet, humid climates increase the cost of feeding. Cattle do not perform satisfactorily when the pens are muddy, and they tend to experience more illnesses under cold damp conditions. Pollution problems resulting from run-off and odor are greater under wet conditions. The long-run average rainfall on the project lands is less than eight inches. The area also has low humidity and considerable sunshine. These conditions are very favorable for cattle feeding.

There are no sizable beef slaughtering plants located close to the project lands. The closest slaughtering facilities are located in Albuquerque, New Mexico. Slaughtering facilities at Phoenix, Arizona, and Pueblo, Colorado Springs, Denver, and Greeley, Colorado are within reach at slightly higher transportation costs. At certain times of the year, fed cattle are frequently shipped live to slaughtering plants in California from western Texas and eastern New Mexico. This market would also be available for cattle fed on the project lands.

Beef finishing feedlots in the West are typically large agri-businesses involving considerable operating and investment capital. They are generally not a supplemental business to a farming operation. Because of this, beef finishing feedlots were not budgeted for the 320-, 640-, and 1280-acre farms.

There are considerable economies of size in beef feeding. Important factors determining economies are labor specialization, equipment specialization, purchasing and marketing. Feedlots obtain most economies of size

after attaining a capacity of 15,000 head. Additional slight economies are probably available beyond 15,000 head, particularly in feed processing, marketing, and overhead expenses. Most feedlots built in recent years in the Southwest range in size from 10,000 to 35,000. A 15,000-head lot is large enough to afford an efficient steam flake feed processing mill and scales capable of handling semi-trucks.

A 15,000-head finish feedlot was budgeted as an alternative business for the tribal enterprise farm.

Assumptions used in budgeting the feedlot were as follows:

1. Cost of building pens and related equipment, feed mill and storage facilities, and feed truck and transportation equipment were obtained by adjusting upward by 30 percent the figures given in "Cattle Feeding in California," by John Hopkins and Robert Kramer, published by the Bank of America, 1965.
2. Cost of other miscellaneous investments, including office, office equipment, and scales, were obtained from interviews with feedlot managers in New Mexico, Texas, and Colorado.
3. The feedlot would operate at approximately 90 percent of capacity and feed, on the average, two groups of cattle annually for every pen. Total annual output would be 27,100 head.
4. Average cattle inventory would be 13,550 head. The lot would maintain a 15-day supply of feed in inventory.
5. Rations consist primarily of 1) corn or milo at $46.00 per ton, 2) corn silage at $7.50 per ton in the pit and $10.00 per ton fed, 3) alfalfa hay at $32.00 per ton out of the stack, 4) sugar beet tops at $5.00 per ton, and 5) protein supplement at $85.00

per ton. Average ration ingredient cost was budgeted at $47.44 per ton. The average conversion ratio was 8.2 to 1 on an air dry basis.

6. Average gain was 425 pounds on steers and 350 pounds on heifers. It was assumed that two pens of steers are fed for every one pen of heifers. Total annual pounds of gain for the feedlot was budgeted at 10,840,000.
7. Average in-weight of steers was 615 pounds and of heifers, 560 pounds. Average out-weight allowing for a four-percent shrink was 1,040 pounds for steers and 910 pounds for heifers.
8. A one-percent death loss allowance was included: 9,033 heifers were purchased and 8,943 were sold; 18,338 steers were purchased and 18,157 were sold.
9. Prices for feeders and fed cattle were based on Clovis, New Mexico average quotations from 1967 through 1970, assuming two-thirds graded Choice and one-third graded Good.
10. Depreciation was based on the straight-line method with an approximate average life of 20 years.

Annual net operating profit for the feedlot was projected to be $436,516 or $16.11 per head marketed (table 29). This profit estimate does not include a charge for land, property taxes, or interest on the animal and feed. Most feedlot operators strive for a profit of four to five dollars per head fed as a return to the investment in facilities. Seven to eight dollars per head fed has been a typical average profit to the owner of the cattle in the feedlot in the past four years.

Table 29. Annual projected income statement for a 15,000-head capacity feedlot, Navajo Indian Irrigation Project

Item	Per Head Marketed	Total
	. . . .dollars.	
Sales	268.57	7,278,185
Purchases	164.49	4,457,589
Gross profit	104.08	2,820,596
Expenses		
Feed	77.80	2,108,423
Labor and management	4.89	132,624
Depreciation	1.68	45,528
Utilities	.56	15,176
Gasoline, oil, grease	.32	8,680
Maintenance repairs	1.00	27,037
Veterinary and medicine	1.40	37,940
Other	.32	8,672
Total	87.97	2,384,080
Net operating profit	16.11	436,516

Feed was the single largest expense item,amounting to slightly more than 88 percent of total expenses (table 29). Labor was the next largest expense,amounting to nearly 50 percent of nonfeed expenses.

Capital invested in feedlot facilities and equipment was expected to be $825,000 (table 30). This amounts to $55.00 per head of capacity. The investment in pens and related equipment amounts to about the same as the investment in the feed mill and feed storage for a 15,000-head feedlot. Expansion of the feedlot beyond 15,000 head would require a near proportional increase in the investment in feedlot pens and related equipment. A doubling of the feedlot capacity would not require doubling the investment in milling facilities. Many of the basic items in the mill and storage facility would not require expansion.

Feedlots require substantial amounts of operating capital. Operating capital requirements to finance the cattle and feeding for the 15,000-head feedlot was estimated at $3,398,115.

The 15,000-head feedlot was expected to provide employment to about 20 people (table 31). Feedlot personnel typically work 50 to 60 hours per week. Of the 20 jobs created, 5 would be classified as supervisory and management positions.

Cow-Calf Production

The Four Corners Region is a major producer of beef calves. Beef calf production is an important agricultural activity on the Navajo Indian Reservation.

There is a national market for beef calves. Texas, Colorado, Oklahoma, Kansas, Iowa, and Illinois are major destinations for calves from New Mexico

Table 30. Capital investments in facilities and equipment for a 15,000-head one-time capacity feedlot, Navajo Indian Irrigation Project

Item	Per Head of Capacity	Total
	. . . .dollars.	
Pens, related equipment, water	23.47	352,050
Feed mill and storage	23.53	352,950
Feed truck and transportation	3.65	54,750
Other[1]	4.35	65,250
Total	55.00	825,000

1 Includes office, office equipment, scale, and other miscellaneous items.

Table 31. Labor needs, total monthly wages, and weekly man-hour requirements for a 15,000-head capacity feedlot, Navajo Indian Irrigation Project

Position	Number Employed	Total Monthly Wages	Weekly Labor Requirements
		dollars per individual	man-hours
General manager	1	1,320	60
Office manager	1	750	45
Feed mill supervisor	1	750	50
Yard foreman	1	750	50
Cowboy foreman	1	750	50
Cowboys	5	444[1]	50
Feeders	2	444[1]	50
Feed mill laborers	3	444[1]	50
Maintenance and pen cleanup	3	444[1]	50
Secretary	1	420	40
Bookkeeper	1	480	40

1 Based on a $2.22 hourly wage rate including fringe benefits.

ranches. The recent increase in number and size of feedlots in eastern New Mexico, west Texas, and the Oklahoma Panhandle has increased the regional demand for New Mexico-produced calves.

A cow-calf operation on irrigated pastures was included as a possible production alternative for the three individually operated farm sizes and the tribal enterprise farm on the Navajo Indian Irrigation Project. Irrigated summer pasture and wheat pasture are the major sources of feed. This contrasts with the additional concept of range beef production in the region. Primary reasons for including cow-calf operations as an alternative are 1) the Navajo people are experienced herdsmen, 2) production of cattle and calves requires less intensive management than many of the field, vegetable, and fruit crops being considered for production, and 3) the long-run demand and price situation for beef calves appears very favorable.

The following assumptions were used in developing the cow-calf budgets for each farm size:

1. Livestock would be grazed on wheat fields during November through March, placed in a drylot during April, grazed on irrigated pastures during the months of May through September, and grazed on grain field stubble in October.
2. The cow-calf activity unit consisted of .75 cows per acre, one bull per 25 cows, and 16-percent replacement heifers, or a total of approximately .9 animal units per acre. Hence, each acre of irrigated pasture would produce slightly more than 1 animal unit per year used in conjunction with winter small grain production.

3. Annual cash production costs attributed directly to livestock on a per acre basis were:

a) Alfalfa hay during drylot period	$8.26
b) Salt	$ .45
c) Bull replacement	$3.12
d) Veterinary and medical	$1.48
e) Repair and maintenance on livestock equipment	$ .76

4. Depreciation was calculated using the straight-line method. No salvage value was assumed. Fences and livestock water facilities were depreciated over a 15-year life, corrals over a 20-year life, and horses over a 10-year life.

5. Livestock production was based on a 90-percent calf crop and a 1-percent death loss of the cows and bulls. Steer and heifer calves would be marketed at an average of 425 and 385 pounds, respectively.

6. Cows and bulls would be replaced, on the average, after seven and four years, respectively. Cull cows were assumed to weigh 950 pounds and bulls 1,450 pounds each.

7. Cattle prices are based on five-year averages (1965-1969) of the Clovis, New Mexico market for the month of sale. Calves are sold during the month of October, and cows and bulls are sold in either late spring or early summer. Prices used are steers at $28.82 per hundredweight; heifers at $25.93 per hundredweight; cull cows at $17.00 per hundredweight; and bulls at $22.00 per hundredweight.

8. Livestock labor requirements are approximately 4.88 hours per acre annually.

9. Production costs, returns, and labor requirements for wheat and irrigated pasture production vary depending on the size of the farm. Cost, return, and labor requirements were obtained from New Mexico State University Agricultural Experiment Station Research Reports 194 and 199.

It is anticipated that the land devoted to the cow-calf activity would be 50-percent wheat and 50-percent irrigated pasture. The irrigated pasture is divided into six pastures of equal size. Cattle are rotated every five or six days into different pastures. After the animals are moved from one pasture, it would be 25 to 30 days before the pasture would again be grazed. It was assumed that at least 120 acres would be planted to irrigated pasture and small grains. Acreages less than 120 were not considered feasible. A per-acre annual income statement for the cow-calf operation by farm size is shown in table 32. The net operating profit on the 320-, 640-, and 1280-acre farms was $4.85, $8.31, and $15.02 per acre, respectively. The tribal enterprise farm had the greatest net operating profit of $30.66 per acre. The major reason for increase in net operating profit with the increase in farm size is that wheat and irrigated pasture production costs decrease as the farm size increases. Wheat and irrigated pasture production costs account for over 65 percent of total enterprise expenses. The major difference between profits and costs on the tribal enterprise farm and the individual farms was the $20 per acre land rent for the individual farms and the management charge for the tribal enterprise farm.

It is very unlikely that the cow-calf activity would involve less than 60 acres, or a minimum of 42 cows. For budgeting purposes, 640 acres

Table 32. Cow-calf operation, budgeted costs and returns per acre for individually operated farms of 320-, 640-, and 1280-acres and the tribal enterprise farm, Navajo Indian Irrigation Project

	Individually Operated Farm			Tribal Enterprise Farm
	320-acres	640-acres	1280-acres	
	. . . . . dollars per acre.			
Income				
Steers (1.414 cwt. per acre)	40.76	40.76	40.76	40.76
Heifers (.824 cwt. per acre)	21.37	21.37	21.37	21.37
Cows (cull)	17.16	17.16	17.16	17.16
Bulls (cull)	1.99	1.99	1.99	1.99
Wheat[1]	43.88	43.88	43.88	50.40
Gross Receipts	125.16	125.16	125.16	131.68
Expenses				
Wheat (1/2 acre)[2]	46.55	44.48	39.17	34.30
Pasture (1/2 acre)[2]	48.75	47.36	45.96	32.92
Alfalfa hay	8.26	8.26	8.26	8.26
Salt	.45	.45	.45	.45
Bull replacement	3.12	3.12	3.12	3.12
Veterinary and medical	1.48	1.48	1.48	1.48
Repairs and maintenance (livestock equipment)	.11	.11	.11	.11
Labor (livestock)	10.83	10.83	10.83	12.72
Depreciation expense (livestock equipment)	.76	.76	.76	.76
Supervision and management[3]				7.90
Total Expenses	120.31	116.85	110.14	101.02
Net operating profit	4.85	8.31	15.02	30.66

1 Wheat returns are based on one-half acre. Yields on individually operated farms and the tribal enterprise farm are 67 and 72 bushels per acre, respectively. Price received for wheat on individually operated farms is $1.31 per bushel. Wheat price on the tribal enterprise farm is $1.40 per bushel.

2 One-half of total per acre production expenses for each crop. Supervision and management charges are excluded on the tribal enterprise farm. Land charge of $20 per acre was included for the individual farm budgets, but not for the tribal enterprise farm.

3 Supervision and management charges are computed at six percent gross returns for the tribal enterprise farm.

were assumed to be a minimum-size unit on the tribal enterprise farm and 120 acres on the individual farms. An estimated initial investment of $273.21 was required for livestock and livestock facilities (table 33). This does not include the complement of machinery and equipment necessary for production of wheat and irrigated pasture.

Operating capital required per acre to produce forage and livestock was budgeted at $102.13 on the 320-acre farm, $99.60 on the 640-acre farm, $88.14 on the 1280-acre farm, and $77.49 on the tribal enterprise farm.

Total annual labor requirements per acre for production of the pasture crops and livestock are 12.73 hours on the 320-acre farm, 12.22 hours on the 640-acre farm, and 10.01 hours on the 1280-acre farm and the tribal enterprise farm.

Yearling Grazing

The presence of a national market and a large number of yearling steers marketed in the Four Corners Region was the basis for considering a steer grazing operation for the Navajo Indian Irrigation Project.

A yearling steer activity was budgeted for the tribal enterprise farm. Steers would be grazed on irrigated pastures from May through September. The stocking rate was budgeted at four steers per acre. Average daily weight gain per steer was calculated at 1.75 pounds.

The following assumptions were utilized in developing the steer budgets for the tribal enterprise farm:

1. Steers averaging 400 pounds were purchased during the last of April or early May and sold after 150 days.

Table 33. Investment in livestock and livestock facilities for a cow-calf operation, Navajo Indian Irrigation Project

Item		Investment Per 640-acres	Investment Per acre
		. . .dollars. . .	
Livestock			
Cows	475 @ $300	142,500.00	222.65
Heifers	76 @ $200	15,200.00	23.75
Bulls	19 @ $500	9,500.00	14.84
Horse and saddle	2 @ $250	500.00	.78
Total livestock		167,700.00	262.02
Livestock facilities			
Fence		2,858.10	4.47
Corrals		2,500.00	3.91
Water facilities		1,800.00	2.81
Total livestock facilities		7,158.10	11.19
Total investment		174,858.10	273.21

2. Steers would be grazed on irrigated pasture for the five-month period from May through September. Carrying capacity of the irrigated pasture was budgeted at 2.3 animal units per acre (4 steer units) for the grazing period. One steer is equivalent to approximately .58 animal units.

3. Annual cash production expenses on a per acre basis were:

a) Salt	$2.00
b) Veterinary and medicine	$8.00
c) Repair and maintenance on livestock equipment	$ .21

4. Depreciation was calculated using the straight-line method. No salvage value was assumed. Fences and livestock water facilities were depreciated over a 15-year life, corrals over a 20-year life, and horses over a 10-year life.

5. Livestock production was based on an average gain of 262 pounds per steer minus a four-percent shrink. Death loss was computed at three percent.

6. Steer prices were based on the Clovis, New Mexico market average for the month of purchase and sale during 1966-1969. Prices were based on Choice steers. Prices used were $30.39 per hundredweight for purchasing and $26.49 per hundredweight for selling.

7. Labor requirements for livestock were approximately 5.50 hours per acre per grazing season. The total labor requirements for producing irrigated pasture and caring for the livestock were 11.69 man hours per acre.

Management practices employed in the yearling steer activity would be similar to those in the cow-calf activity on irrigated pasture. The

irrigated pasture would be divided into six pastures of equal size. Steers would be rotated after grazing five or six days in each pasture.

For budgeting purposes, 320 acres were assumed to be the minimum unit size. One unit would carry a total of 1,280 steers for the five-month period.

The net operating profit per acre was budgeted at $58.65 (table 34). The largest expense, excluding purchasing steers, was the irrigated pasture cost. Approximately 65 percent of total expenses was attributed to pasture costs.

The required investment for livestock facilities and a horse for the 320-acre activity was $7,155.20 or $22.36 per acre (table 35). Total initial investment in cropping equipment, sprinkler system, and livestock facilities was approximately $200 per acre. The total annual operating capital required per acre was $579. Capital required for purchasing steers is included in operating capital.

Labor devoted to livestock was 5.50 man hours per acre. Total labor required for production of irrigated pasture and care of the livestock was 11.69 man hours per acre.

Table 34. Steer operation, budgeted costs, and returns per acre for the tribal enterprise farm, Navajo Indian Irrigation Project

Item	Total dollars
Income	
Steers (2468 lbs. @ $26.49/cwt.)	653.77
Gross Receipts	653.77
Expenses	
Pasture	70.39
Salt	2.00
Steer purchase (1600 lbs. @ $30.39/cwt.)	486.24
Veterinary and medicine	8.00
Repairs and maintenance (livestock equipment)	.21
Labor (livestock)	14.36
Depreciation expense (livestock equipment)	1.42
Supervision and management	12.50
Total Expenses	595.12
Net operating profit	58.65

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Table 35. Investment per acre in livestock and livestock facilities for a steer program, Navajo Indian Irrigation Project

Item	Investment
	dollars
Livestock facilities	
Fence	7.36
Corrals	7.81
Water facilities	5.63
Total livestock facilities	20.80
Livestock	
Horse and saddle	1.56
Total investment	22.36

EXPECTED CROP AND LIVESTOCK COMBINATIONS

Method of Analysis

Linear Program

A mathematical technique called linear programming was used to determine the combinations of crop, livestock, and processing activities (listed in tables 1 and 15) that would return the greatest profit for the tribal enterprise farm and individually operated farms of 320, 640, and 1280 acres.

Linear programming may be used to determine the optimum allocation of resources (such as capital, raw materials, manpower, or facilities) to obtain a particular objective. For example, maximum profit or minimum cost may be the objective when there are alternative uses for the resources. Linear programming is a budgeting tool capable of handling large amounts of data. The results of this technique can provide information on the value of additional resources which are limited in quantity and the effects of given price changes in inputs and products on the profit or loss of a business.

Linear programming was used to select those crop and livestock combinations that would realize the maximum amount of profit for the total 110,630-acre project developed under the assumptions of 320-, 640-, and 1280-acre farms, and a tribal enterprise farm. Linear programming was also used to identify optimum profit combinations of crop and livestock activities during the development phase of the irrigation project. The phase-in periods included those solutions from the first 10,000-acre block of project to 110,630 acre in increments of 10,000 acres. Only those crop and livestock enterprises appearing in the optimum solution for the fully

developed project were used as alternatives for the phase-in periods. This approach was taken because it would be unadvisable to build processing and marketing facilities for crops that would not likely be produced on the project in the long run.

Prior to subjecting the crop and livestock enterprises to the linear programming technique, it was evident that certain crops and/or livestock enterprises would dominate the optimum solution because their net returns were considerably greater than other enterprises. It also was evident that practical, agronomic, and managerial limitations would dictate the sequencing of crop and livestock activities during the phase-in period. Therefore, specific assumptions and constraints were used to arrive at profit-maximizing solutions consistent with risks and uncertainties associated with changes in market prices and possibilities of disease, insect, and weed infestations.

Constraints Used in Programming for the Fully Developed Project

The following are constraints applied in determining the crop and livestock combinations for the fully developed project.

1. No more than 110,630 acres of land could be used.
2. Irrigation water consumptive use cannot exceed 2.3 acre-feet per acre of land developed or 254,000 acre-feet for the entire project.
3. Maximum acreage limitations for crops on all individually operated farms and the tribal enterprise farm are listed in table 36.
4. No apple production on the individually operated farms.
5. The maximum number and type of livestock activities could not exceed those presented in table 37.

No restrictions were placed on labor or capital.

Table 36. Maximum allowable acreage of selected crops under alternative farm organizational structures, Navajo Indian Irrigation Project

Crop	Individually Operated Farms	Tribal Enterprise Operated Farms
	acres	acres
FIELD CROPS		
Sugar beets	27,658	22,126
Alfalfa hay	55,315	44,252
Dry beans	4,800	4,800
Soybeans	55,315	36,787
Grain sorghum	55,315	36,787
Corn grain	55,315	36,787
Corn silage[1]	55,315	36,787
Winter barley	55,315	36,787
Winter wheat	55,315	36,787
Irrigated pasture	55,315	36,787
SEED CROPS		
Alfalfa	1,200	1,200
FRUIT CROPS		
Apples[2]		500
VEGETABLE CROPS		
Fresh Market		
Bell peppers	500	500
Carrots	2,50	2,500
Onions	915	915
Potatoes	2,500	2,500
Processed Vegetables		
Asparagus	2,955	2,486
Beets	138	120
Cabbage	129	110
Carrots	130	111
Cucumbers	548	460
Snap beans	1,600	1,333
Sweet potatoes	6?0	572

1 Corn silage production is limited to the amount required as feed inputs into the livestock enterprises or the maximum acreage, whichever is less. No sale activity was included for corn silage.

2 Apples were excluded as a possible crop alternative on the individually operated farms because of low returns.

Table 37. Maximum allowable livestock units, by type, for individually operated farms and tribal enterprise farm, Navajo Indian Irrigation Project

Livestock Enterprise	320-Acre Farm		640-Acre Farm		1280-Acre Farm		Tribal Enterprise Farm	
	number of units	size	number of units	size	number of units	size	number of units	size
Commercial Egg							1	300,000 layer
Dairy							1	1,100 cow
Swine	345	25 sow	172	50 sow	86	100 sow	4	600 sow
Backgrounding Feedlot	345	100 head	69	500 head	35	1,000 head	6	5,000 head
Feedlot							4	15,000 head

The maximum allowable acreage of any one crop for both individually operated farms and the tribal enterprise farm was restricted because of production and marketing risks. Crop and livestock alternatives having high returns generally have high risks. In order to ease the effects of weather or disease on specialized production, maximum restrictions on crop and livestock alternatives were set. The total acreage permitted in any field crop or processing vegetable crop was greater for individually operated farms than for the tribal enterprise farm. For individually operated farms, it was assumed that up to 50 percent of any farm could be planted to a particular field crop. This allows individual farms to specialize in production of certain crops and effectively utilize machinery and equipment. For the tribal enterprise farm, no more than 40 percent of the land could be planted to alfalfa, one-fifth to sugar beets, and other field crops could not exceed one-third of the total planted acreage.

Individually operated farms are expected to produce lower yields of processing vegetables, so larger acreages of these crops would be required to supply the cannery with the required raw vegetable tonnage.

Equal maximum acreages of dry beans, fresh vegetables, and seed crops were established for both farm organization alternatives. Market restrictions were the basis for determining maximum acreages in production of fresh vegetable and seed crops. It was determined that additional acreage, beyond those specified, would tend to depress market prices and result in unprofitable production.

Livestock enterprises which were included as possible alternatives for the individually operated farms were: cow-calf, backgrounding feedlot, and

swine production (table 37). The 320-, 640-, and 1280-acre farms were allowed the option of having a 25-, 50-, and 100-sow operation per farm, respectively.

A 100-head capacity backgrounding feedlot was allowed as an alternative on each 320-acre farm. A 500-head capacity backgrounding feedlot was allowed on the 640-acre farm size; however, only 69 of the farms could have a feedlot of this size because it was assumed that no more than approximately 35,000 calves would likely be backgrounded on the project lands. This assumption was based on the limited supply of calves in the central Four Corners Region and the market for backgrounded cattle. A 1,000-head capacity feedlot was included as a possible alternative on the 1280-acre farm. Only 35 of the 1280-acre farms could have a feedlot and stay within the 35,000-head limit.

The egg producing unit, dairy, and finishing feedlots were not included as possible alternatives on the individually operated farms. It was assumed that the need for large amounts of capital and intensive management would prohibit them from being a part of individually operated farms.

The cropping alternatives included in the linear programming model are shown in table 38. Several of the crops may be used as intermediate products. An intermediate product is a crop that is produced and used as an input to another enterprise. Corn silage is an intermediate product that is produced and then fed to livestock. Corn for grain and alfalfa are also intermediate products when they are consumed by livestock on the farm. However, if these crops are sold in the raw form, they are not considered an intermediate product. Since the linear programming model

Table 38. Cropping alternatives included in the linear programming model, Navajo Indian Irrigation Project[1]

Crop	Produced for Sell	Produced for Feed	Purchased for Feed
FIELD CROPS			
Sugar beets	X		
Alfalfa hay	X	X	X
Dry beans	X		
Soybeans	X		
Grain sorghum	X	X	X
Corn silage		X	
Winter barley	X	X	X
Winter wheat	X		
Irrigated pasture		X	
	Produced for Fresh and Other Markets		Produced for Processing
SEED CROPS			
Alfalfa	X		
VEGETABLE CROPS			
Fresh			
Bell peppers	X		
Carrots	X		
Onions	X		
Potatoes	X		X
Processed			
Asparagus			X
Beets			X
Cabbage			X
Carrots			X
Cucumbers			X
Potatoes			X
Snap beans			X
Sweet potatoes			X
FRUIT CROPS			
Apples	X		

1 The X symbol indicates the activity is included as an option in the linear programming model.

is a maximizing technique, the optimum profit combination of crops might be to purchase feedgrains for livestock from western Kansas and specialize in the production of alfalfa and sugar beets on the project lands. For example, an acre of grain sorghum might return a profit of $31 per acre, but if that acre were planted to grain sorghum, the opportunity to grow alfalfa at $100 profit per acre would be foregone. Total profits are greater by allowing production specialization and purchasing alternatives.

Optimum Crop and Livestock Combinations for the 110,630-Acre Fully Developed Project

The crop and livestock combinations that maximize profits for the various farm sizes for the fully developed project are presented in table 39. It is estimated that approximately 88 percent of the total project land would be planted to field crops and 12 percent to seed and vegetable crops on all farm sizes. The five field crops which appeared to be the most important in terms of acreage on individually operated farms were sugar beets, corn for grain, corn silage, alfalfa, and winter wheat. The four field crops which appeared to be the most profitable on the tribal enterprise farm were sugar beets, alfalfa, corn for grain, and corn silage. Alfalfa for seed and fresh market vegetables would be produced at the maximum acreage allowable on all farm sizes. Under the optimum solution alfalfa hay would be produced at the maximum allowable acreage on the tribal enterprise farm. About six percent of the total acreage would be planted to processing vegetable crops on all farm sizes. It is expected that approximately an equal number of acres would be planted to fresh market vegetables.

Table 39. Profit maximizing crop and livestock combinations for fully developed project, Navajo Indian Irrigation Project

	Units	Individually Operated				Tribal Enterprise	
		Maximum Allowable	Optimum Solution 320-acre	640-acre	1280-acre	Maximum Allowable	Optimum Solution
FIELD CROPS							
Sugar beets	acres	27,658	27,658	27,658	27,658	22,126	22,126
Alfalfa hay	acres	55,315	53,698	53,695	53,697	44,252	44,252
Corn	acres	55,315	3,094	3,111	3,099	36,787	27,661
Corn silage	acres	55,315	1,948	1,954	1,952	36,787	3,787
Winter wheat	acres	55,315	10,477	10,457	10,469	27,661	0
SEED CROPS							
Alfalfa	acres	1,200	1,200	1,200	1,200	1,200	1,200
VEGETABLE CROPS							
Fresh							
Bell peppers	acres	500	500	500	500	500	500
Carrots	acres	2,500	2,500	2,500	2,500	2,500	2,500
Onions	acres	915	915	915	915	915	915
Potatoes	acres	2,500	2,500	2,500	2,500	2,500	2,500
Processed							
Asparagus	acres	2,955	2,955	2,955	2,955	2,486	2,486
Beets	acres	138	138	138	138	120	120
Cabbage	acres	129	129	129	129	110	110
Carrots	acres	130	130	130	130	111	111
Cucumbers	acres	548	548	548	548	460	460
Snap beans	acres	1,600	1,600	1,600	1,600	1,333	1,333
Sweet potatoes	acres	640	640	640	640	572	572
TOTAL ACRES	acres		110,630	110,630	110,630	110,630	110,630
LIVESTOCK ENTERPRISES							
Commercial egg	units[1]					1	1
Dairy	units[2]					2	1
Swine	units[3]					4	4
Backgrounding feedlot	units[5]	4	345	69	35	6	6
Feedlot	units[6]					4	4
CANNERY	number	2	2	2	2	2	2
PURCHASE ACTIVITIES							
Grain sorghum	tons						75,440
SALE ACTIVITIES							
Alfalfa	tons		261,175	248,504	261,156		247,783
WATER UTILIZED	ac.ft.		359,548	359,548	359,548		345,168

1 Each unit represents 300,000 laying hens.
2 Each unit represents 1,100 cows.
3 Each unit represents 600 sows.
4 The upper limit is 345, 69, and 35 units on 320-, 640-, and 1280-acre farm sizes, respectively.
5 Each unit represents 100, 500, 1,000, and 5,000 cows on the 320-, 640-, and 1280-acre and tribal enterprise farms, respectively.
6 Each unit has 15,000-head capacity.

The backgrounding feedlot was the only livestock activity that reached the allowable maximum on all farm sizes. The swine operation did not enter the profit maximizing solution on the individually operated farms. However, it came in at the maximum level of four 600-sow units on the tribal enterprise farm. The egg, dairy, and finishing feedlot activities entered the solution on the tribal enterprise farm at the maximum level. Two cannery units(1,100,000 cases each) would be required to process the vegetables, whether they are produced on the individual farms or on the tribal enterprise farm. The ownership of these canneries could be either by the Tribe, grower cooperatives, or a separate business firm.

The trade-off between swine production and wheat was very close on the individually operated farms. A slight decline in wheat price or a slight increase in the price of swine or a change in the relative production costs or market prices between corn and wheat could result in resources being changed from wheat production to corn and swine production.

Grain sorghum was the only feedgrain which would be purchased by the tribal enterprise farm. The tribal farm livestock enterprises would utilize the corn produced on 27,661 acres and would need an additional 75,440 tons of grain sorghum which would be purchased from sources outside the Irrigation Project. Alfalfa hay sales on all farm sizes would be approximately 250,000 tons.

Water became a restricting resource on the three individually operated farms. The upper limit for water was reached because of the larger acreage allowed in alfalfa production. Alfalfa hay requires more water than any other crop budgeted. If additional water were available, the quantity of land planted to alfalfa would have increased, and wheat acreage would have decreased.

Constraints Used in Programming for
the Phase-In Development Periods

An individually operated farm size of 320 acres was selected for comparison with the 110,630-acre Project farmed as one integrated enterprise farm. Many factors were evaluated in making this decision. Some of these included: 1) investigating past irrigation projects in reference to size of land allotment and the success of these projects, 2) discussion with individuals who had experience with other irrigation projects, 3) discussion with the tribal leaders about the most politically feasible individually operated farm size for the Navajo Indian Irrigation Project, and 4) evaluation of the economic factors affecting the efficiency in the use of machinery and equipment and determining levels of operators' labor income (3).

Hence, optimum crop and livestock combinations were programmed for only the 320-acre farms and the tribal enterprise farm approaches during the phase-in development periods. However, based on the similarity of optimum cropping and livestock combinations among the 320-, 640- and 1280-acre farm sizes for the fully developed project, it is anticipated that the 640- and 1280-acre farms would also have similar optimum combinations during the phase-in period (table 39).

All crop, livestock, and processing enterprises that did not appear in the optimum profit solution for the fully developed project were also eliminated as alternatives for the phase-in periods. These periods are planned to extend over 11 years with approximately 10,000 acres of land available in the first unit (block) and 10,000 acres every year thereafter

until the project is completely developed, except in the last unit, 10,630 acres of land would be brought under cultivation. The quantity of water available during the phase-in period was assumed to be 3.25 acre-feet for each acre of land under cultivation. There were no constraints placed on quantities of capital and labor that could be utilized.

It is anticipated that management limitations could be a problem for the first few years. Hence, it would be desirable to start production with crops that are relatively easy to produce and market. Crop and livestock activities requiring intensive management were excluded from programming alternatives during the start-up period.

Specific constraints.

Block 1

1. Land: 10,000 acres.
2. No fresh or processed vegetables except potatoes and asparagus establishment.
3. No sugar beets.
4. No livestock enterprises except one 5,000-head backgrounding feedlot for the enterprise farm and one 100-head lot operated for each individually operated farm.
5. No seed crops.
6. Allow alfalfa up to 40 percent of total acreage on the enterprise farm and 50 percent on individually operated farms and all other crops up to one-third of the total acreage.
7. No apples.

Block 2

1. Land: additional 10,000 acres for a total of 20,000 acres.
2. Allow alfalfa seed, onions, and for the enterprise farm dairy, two units of backgrounding feedlot, and egg production.
3. Same percentage of total acreage constraints to any one crop as in Block 1.
4. No processed vegetables or sugar beets except asparagus establishment.
5. No apples.

Block 3

1. Land: additional 10,000 acres for a total of 30,000 acres.
2. Allow all fresh vegetable crops.
3. No processed vegetables except asparagus establishment.
4. Allow apples.
5. Allow sugar beets up to 10,000 acres.
6. Livestock enterprises same as Block 2, except allow four units of backgrounding feedlot for the enterprise farm.
7. Same percentage of total acreage constraints to any one crop.

Block 4

1. Land: additional 10,000 acres for a total of 40,000 acres.
2. Allow apples, all fresh vegetables, and processed vegetables at 50 percent of eventual capacity.
3. All livestock enterprises except limit finish feedlot to 15,000 head and hogs to 600 sows on the tribal enterprise farm.
4. Allow sugar beets up to 13,334 acres.

5. Same percentage of total acreage constraints to any one crop.

Block 5

1. Land: additional 10,000 acres for a total of 50,000 acres.
2. Allow sugar beets up to 16,534 acres.
3. Same percentage of total acreage constraints to any one crop.

Blocks 6 through 11

1. All crop and livestock activities allowed up to their maximum levels as described in table 38.

Lower yields and higher production costs were assumed to occur during the early development periods for both organizational alternatives because of production problems and management coordination difficulties. Therefore, all crop budgets for the previously mentioned enterprises were adjusted in the following manner:

	Yields as a percentage of budget expectations	Production costs as a percentage of budget expectations
First 10,000-acre unit		
Number of years farmed		
Year 1	70	130
Year 2	80	120
Year 3	90	110
Year 4	100	100
All additional 10,000-acre units		
Year 1	80	120
Year 2	90	110
Year 3	100	100

The only livestock activity that was allowed to come in with the first unit of production was backgrounding feedlots. Backgrounding feedlots are one of the easiest livestock activities to manage. Livestock activities allowed in the second year included a 1,100-cow dairy, additional units of backgrounding feedlot, and a 300,000-layer egg production unit on the tribal enterprise farm. On the third unit of land that will come into production, no new livestock activities would be allowed except an increase in the number of those already existing. In the fourth unit, all livestock activities would be allowed to come into production. However, not until the fifth year would all livestock be allowed to reach their upper limits on the tribal enterprise farm. With individual farms, the number of backgrounding feedlots could continue to increase until the eleventh year, because the total number of farms would increase with the addition of each unit of land.

All field crops included as possible alternatives during the development period, with the exception of sugar beets, were allowed to come in with the development of the first 10,000 acres of land under the same restraints as on the total project land when fully developed. Alfalfa hay, for example, was allowed to occupy 40 percent of the acreage on the tribal enterprise farm and up to 50 percent on the individually operated farms. Other field crops such as wheat, corn, and corn silage were allowed to occupy up to one-third of the total land on the enterprise farm and one-half of the land on the individual farms.

All processed vegetables except asparagus were excluded as alternatives until the management organization had three years to stabilize. A minimum of four years is required for asparagus to come into full production. If the first unit of the cannery were established on the project land in the

fourth year, asparagus would have to be planted in the first year so that the bed would be mature by the time the cannery is ready for operation. No other vegetables intended for processing were allowed to come in until development of the fourth unit. Potatoes were the only fresh market vegetable allowed to be produced during the first year. Onions were allowed when the second 10,000 acres came into production, and carrots and bell peppers with the development of the third block. Fresh vegetable crops were allowed to come in at 50 percent of their maximum upper limits the first year of production of each crop and at 100 percent of their maximum allowable acreage in the second year the crop is produced. For example, 1,250 acres of potatoes were allowed to be planted with the first unit, and an increase of 1,250 was allowed with the second unit, making a total of 2,500 acres of potatoes, the maximum allowable under full development.

Crop and Livestock Combinations during Phase-In Periods

Optimum solution - 320-acre farm approach. Based on the marketing and individual crop acreage restrictions, the optimum solution for the first 10,000 acre block included nearly 5,000 acres of alfalfa, 2,000 acres of wheat, 1,250 acres of potatoes, 1,477 acres of asparagus, 250 acres of corn silage, and 31 background feedlots or one per farm (table 40). Hence, an average farm would have approximately 160 acres of alfalfa, 66 acres of wheat, 47 acres of asparagus, 40 acres of potatoes, 7 acres of corn silage, and background 100 head of calves. One would expect, however, for farmers to specialize in certain crops and not all farms would be exactly alike. The field crops, alfalfa hay, corn silage,

Table 40. Crop and livestock combinations during phase-in period for 320-acre farms, Navajo Indian Irrigation Project

Activity	Units	Acreage Developed										
		10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,630
FIELD CROPS												
Sugar beets	acres			9,919	12,877	16,048	19,847	23,279	26,667	27,658	27,658	27,658
Alfalfa hay	acres	4,941	9,551	10,405	13,798	18,696	25,118	31,680	37,838	42,650	48,005	53,698
Corn	acres											3,178
Corn silage	acres	250	438	606	764	938	1,111	1,286	1,468	1,642	1,817	2,005
Wheat	acres	2,082	3,499						272	4,295	8,765	10,336
SEED CROPS												
Alfalfa	acres		600	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
VEGETABLE CROPS												
Fresh												
Bell peppers	acres			250	500	500	500	500	500	500	500	500
Carrots	acres			1,250	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Onions	acres		458	915	915	915	915	915	915	915	915	915
Potatoes	acres	1,250	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Processed												
Asparagus	acres	1,477	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955
Beets	acres				86	163	186	146	138	138	138	138
Cabbage	acres				81	152	136	129	129	129	129	129
Carrots	acres				82	153	137	130	130	130	130	130
Cucumbers	acres				342	645	577	548	548	548	548	548
Snap beans	acres				1,000	1,882	1,684	1,600	1,600	1,600	1,600	1,600
Sweet potatoes	acres				400	753	674	640	640	640	640	640
TOTAL LAND	acres	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,630
LIVESTOCK ENTERPRISE												
Backgrounding feedlot	units	31	62	93	125	156	187	218	250	281	312	345
PURCHASE ACTIVITIES												
Alfalfa	tons	657										
Grain sorghum	tons	878	1,756	2,633	3,539	4,417	5,295	6,173	7,079	7,957	8,835	
SALES ACTIVITIES												
Alfalfa	tons		18,450	41,007	48,959	64,027	87,085	117,703	149,932	180,206	204,706	229,831
WATER												
Available	ac.ft.	32,500	65,000	97,500	130,000	162,500	195,000	227,500	260,000	292,500	325,000	359,548
Utilized	ac.ft.	14,231	46,649	86,130	105,345	131,540	162,949	199,574	237,054	273,418	303,767	338,536

and wheat are used by the livestock operations. Similar crop and livestock combinations exist for the second development period. Sugar beets replaced wheat acreage and the alfalfa hay acreage increased slightly during the third development period. Additional vegetable crops such as bell peppers, carrots, and onions were allowed as alternative for the first time and entered the optimum solution. The number of feedlots also increased.

The cropping pattern was similar from the fourth through the seventh development period. The vegetable crop acreage was constant after the development of the sixth block of land due to the operating capacity of the packing and processing facilities as well as the marketing constraints. Alfalfa hay and sugar beet acreages increase each development period in line with constraints set for these two field crops.

Sugar beet acreage reaches its maximum (27,658 acres) during the ninth development period; thereafter, wheat entered into the optimum solution again (table 40).

Optimum solution - enterprise farm approach. Field crops accounted for over 7,000 acres of the first block of land (table 41). The main crops entering the solution for the first 10,000 acres were 4,000 acres of alfalfa and 3,000 acres of corn. Part of the production of these crops was used for feeding cattle in the 5,000-head backgrounding feedlot which also entered the programming solution.

Additional livestock activities were allowed to enter the solution during the development of the second block of land. These included the 300,000-laying hen operation, the 1,104-cow dairy, and an additional 5,000-head capacity backgrounding feedlot. These livestock activities require a

Table 41. Crop and livestock combinations during phase-in period for tribal enterprise farm, Navajo Indian Irrigation Project

Activity	Units	Acreage Developed										
		10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,630
FEED CROPS												
Sugar beets	acres			7,067	11,484	15,774	19,713	22,126	22,126	22,126	22,126	22,126
Alfalfa hay	acres	4,000	8,000	10,461	12,058	14,740	21,407	28,000	32,000	36,000	40,000	44,252
Corn	acres	3,142	4,817	2,225	2,002	2,002	2,002	3,283	9,283	15,283	21,283	27,661
Corn silage	acres	365	1,139	1,646	2,664	4,200	3,928	3,784	3,784	3,784	3,784	3,784
SEED CROPS												
Alfalfa	acres		600	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
VEGETABLE CROPS												
Fresh												
Bell peppers	acres			250	500	500	500	500	500	500	500	500
Carrots	acres			1,250	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Onions	acres		458	915	915	915	915	915	915	915	915	915
Potatoes	acres	1,250	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
Processed												
Asparagus	acres	1,243	2,486	2,486	2,486	2,486	2,486	2,486	2,486	2,486	2,486	2,486
Beets	acres				75	141	126	120	120	120	120	120
Cabbage	acres				69	129	116	110	110	110	110	110
Carrots	acres				70	131	117	111	111	111	111	111
Cucumbers	acres				287	541	484	460	460	460	460	460
Snap beans	acres				833	1,569	1,404	1,333	1,333	1,333	1,333	1,333
Sweet potatoes	acres				357	672	602	572	572	572	572	572
TOTAL LAND	acres	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,630
LIVESTOCK ENTERPRISES												
Commercial egg	units			1	1	1	1	1	1	1	1	1
Dairy	units			1	1	1	1	1	1	1	1	1
Swine	units					1	4	4	4	4	4	4
Backgrounding feedlot	units		1	2	4	6	6	6	6	6	6	6
Feedlot	units					1	4	4	4	4	4	4
CANNERY	units					1	2	2	2	2	2	2
PURCHASE ACTIVITIES												
Alfalfa	tons	1,058										
Grain sorghum	tons			7,826	49,352	165,435	165,435	161,841	144,560	125,161	104,128	82,021
SALES ACTIVITIES												
Alfalfa	tons		12,183	34,067	48,412	53,654	69,090	106,646	146,323	171,871	195,859	219,871
Corn	tons	5,982	1,424									
WATER												
Available	ac.ft.	32,500	65,000	97,500	130,000	162,500	195,000	227,500	260,000	292,500	325,000	359,548
Utilized	ac.ft.	16,673	47,201	80,138	108,072	130,872	153,779	191,408	232,842	264,682	296,522	329,436

substantial amount of feedstuffs; therefore, alfalfa, corn, and corn silage acreage increased during this period.

The third development period solution shows that sugar beets, bell peppers, and carrots were allowed as alternative crops for the first time during the development of the third block of land. Acreage of sugar beets amounted to nearly 7,000 and carrot acreage amounted to 1,250. Two units of the backgrounding feedlot also entered the solution.

Additional processed vegetable crops such as beets, cabbage, carrots, cucumbers, snap beans, and sweet potatoes entered the solution during the fourth development period. The addition of these crops coincided with the addition of a vegetable cannery.

Processed and fresh vegetable acreage remain constant from the fifth period through the rest of the development periods with marketing restrictions and production capacity of the cannery being the main reason for this constant acreage. The livestock activities also remain constant after the fifth development period. Livestock activities, especially the dairy and feedlots, are heavy users of roughages such as alfalfa hay and corn silage. The corn silage acreage is nearly constant after the fifth development period because all this roughage is consumed by the livestock activities. The alfalfa hay not consumed by livestock is sold.

CAPITAL REQUIREMENTS

Sources of Capital, Labor, and Income Estimates

The programming solutions presented in tables 40 and 41 provided the basis for estimating the investment and operating capital requirements, labor requirements by season by cultural practice, net returns, and investment requirements for equipment and irrigation systems for each farm organizational alternative. The information taken from these optimum combinations provided a partial basis for comparing the two alternative farm organizational structures in terms of investment and operating capital requirements, income generated to the Tribe and to individual farm operators, and employment created.

To complete the comparison, similar information was needed for infrastructure, the non-revenue producing element of the Irrigation Project, for both farm organizational structure alternatives. Information was obtained from several state, federal, and Navajo agencies pertaining to the investment and maintenance costs of housing, administrative buildings, warehouses, domestic water supply systems, utility systems, and other facilities necessary for the operation of the Irrigation Project under both alternative organizational structures.

All conclusions were based on comparisons of capital requirements, employment created, and income generated as derived by the assumptions and techniques previously mentioned.

Capital needs for development of the Irrigation Project will be substantial regardless of the organizational structure selected by the Tribe. Investment capital will be necessary to construct facilities, purchase machinery, and

develop infrastructure. Operating capital will also be needed to purchase farm inputs, defray labor and other expenses, maintain inventory, and operate the main infrastructure. Estimates of investment and operating capital needs by development periods and by type of activity for both organizational approaches are included in this section.

The installation of the main water delivery system will be paid for by the U. S. Government, but the maintenance cost will be paid for by the water users and is included in the operation and maintenance costs or irrigation water costs as shown in New Mexico Agricultural Experiment Station Research Reports 194 and 199.

Investment Capital - 320-Acre Farm Approach

Total investment capital required to fully develop the Irrigation Project under the individually operated farm approach will approximate 50.4 million dollars (table 42). Fifty percent of this total will be needed for direct farm investments on the 345 individual farms. This will include the purchase of all farm machinery, equipment, and livestock facilities. Approximately 16.3 million dollars will be needed to establish infrastructure. This will include construction of administrative offices, purchasing of administrative vehicles, and installing of utility systems (table 43). The remaining 8.9 million dollars will be needed to establish vegetable processing, packing, and custom service facilities to provide the necessary services and market outlets (table 44).

The investment required for each 10,000-acre development for the 320-acre farm approach is relatively constant (table 45). The main reason for this is the farm machinery requirements for the individual farms are similar during all development periods. The farm machinery complements

Table 42. Total investment requirements for farms, agriculturally related businesses, and infrastructure for the number of acres developed on the basis of 320-acre farms, Navajo Indian Irrigation Project

Total Land Developed	Number of 320-Acre Farms	Farm Investment	Investment in Agriculturally Related Businesses	Infrastructure Investment	Total Investment
acres	units	thousand dollars			
Startup				1,913	1,913
10,000	31	2,265	524	3,355	6,144
20,000	62	4,530	1,090	4,767	10,387
30,000	93	6,795	2,486	6,209	15,490
40,000	125	9,133	4,968	7,651	21,752
50,000	156	11,398	7,018	9,063	27,479
60,000	187	13,663	7,385	10,505	31,553
70,000	218	15,928	7,735	11,947	35,610
80,000	250	18,266	8,110	13,359	39,735
90,000	281	20,531	8,405	14,801	43,737
100,000	312	22,796	8,615	16,243	47,654
110,630	345	25,207	8,920	16,243	50,370
110,630 Fully Developed	345	25,207	8,920	16,273	50,400

Table 43. Estimated cost of constructing, operating, and maintaining infrastructure by number of acres developed, for individually operated 320-acre farms, Navajo Indian Irrigation Project

Item	Number of Acres Developed (Thousand Acres)											
	Startup	10	20	30	40	50	60	70	80	90	100	110
	thousand dollars											
Homes												
Construction (345)[1]	465	465	465	465	465	465	465	465	465	465	525	
Administration Offices												
Construction[2]	130											
Maintenance[3]		7	7	7	7	7	7	7	7	7	7	7
Depreciation[4]		7	7	7	7	7	7	7	7	7	7	7
Water System												
Construction[5]	812	582	582	582	582	582	582	582	582	582	582	
Maintenance[3]		41	70	99	128	157	186	215	244	273	303	333
Depreciation[4]		54	93	132	171	209	248	287	326	365	403	441
Electricity												
Construction[5]	130	130	130	130	130	130	130	130	130	130	130	
Maintenance[3]		7	7	7	7	7	7	7	7	7	7	7
Fire Station												
Construction[6]	32											
Depreciation and maintenance[3]		3	3	3	3	3	3	3	3	3	3	3
Administrative Vehicles												
Purchase	25	25		25	25		25	25		25	25	
Maintenance[3]	12	24	24	24	24	24	24	24	24	24	24	24
Depreciation[4]		8	17	17	17	17	17	17	17	17	17	17
Office Supplies	2	2	2	3	3	3	4	4	4	5	5	5
Extension Personnel Salaries	75	100	125	150	150	150	150	150	150	150	150	150
Infrastructure Salaries	43	55	67	72	72	86	86	86	86	86	86	86
Sub-total	1,726	1,510	1,599	1,723	1,791	1,847	1,941	2,009	1,966	2,146	2,274	1,080
Contingency Factor (20%)	345	302	320	345	358	369	388	402	393	429	455	216
Total	2,071	1,812	1,919	2,068	2,149	2,216	2,329	2,411	2,359	2,575	2,729	1,296

1 Cost for homes, including corrals, sheds, and other items furnished by Bureau of Indian Affairs.
2 Costs were developed by Navajo Indian Irrigation Project team based on current construction costs.
3 All maintenance costs are based on five percent of original investment.
4 Depreciation calculated by straight-line method with all items being depreciated over 20 years except for vehicles, those being depreciated over 3 years.
5 Basic cost information furnished by Navajo Tribal Utility Authority.
6 Cost furnished by New Mexico State University Physical Plant.

Table 44. Investment and operating capital requirements for tribal-owned packing and processing facilities, Navajo Indian Irrigation Project

Facility	Accommodates	Investment Capital	Operating Capital
	units	. . . . .dollars.	
Packing shed			
Bell peppers	500 acres	75,000	167,875
Carrots	2,500 acres	366,590	1,221,553
Onions	915 acres	80,600	213,743
Potatoes	2,500 acres	512,500	532,000
Seed Processing			
Alfalfa seed	1,200 acres	67,500	10,080
Processing			
Cannery	2,200,000 cases	2,910,878	6,901,850
Total		4,013,068[1]	9,047,101

1 Does not include the 4,906,932 estimated investment needed for machinery and equipment for custom farm activities.

Table 45. Investments in farms, agriculturally related businesses, and infrastructure for each additional block of land developed on the basis of 320-acre farms, Navajo Indian Irrigation Project

Total Land Developed	Number of 320-Acre Farms	Farm Investment	Investment in Agriculturally Related Businesses	Infrastructure Investment	Total Increase in Investment
acres	units	. . . . . thousand dollars			
Startup				1,913	1,913
10,000	31	2,265	524	1,442	4,231
20,000	62	2,265	566	1,412	4,243
30,000	93	2,265	1,396	1,442	5,103
40,000	125	2,338	2,482	1,442	6,262
50,000	156	2,265	2,050	1,412	5,727
60,000	187	2,265	367	1,442	4,074
70,000	218	2,265	350	1,442	4,057
80,000	250	2,338	375	1,412	4,125
90,000	281	2,265	295	1,442	4,002
100,000	312	2,265	210	1,442	3,917
110,630	345	2,411	305	0	2,716
110,630 Fully Developed	345	0	0	30	30

for the individual farms include only equipment needed to perform general farm practices, such as plowing, disking, planting, and cultivating. It was assumed that specialized equipment such as harvesting machinery for intensive crops will not be purchased by these individual farming units because the acreage of these crops does not warrant the purchase of this costly seasonal equipment. The cost of purchasing the equipment needed for providing custom services is included in the investment in agricultural related businesses in table 45. The farmers would hire these services on a custom basis. Approximately $73,000 per farm on the average, will be needed to purchase farm equipment and irrigation systems and to construct and equip feedlot facilities. The irrigation system is the most costly item, requiring $32,000 per 320-acre farm. It will take approximately $34,800 to furnish the individual farm operator with all necessary farm machinery and equipment. The 100-head backgrounding feedlot will require approximately $6,400 in investment capital.

The only basic change in predicted investment requirements for the total project occurred during the development of the third, fourth, and fifth blocks of land (table 45). It was assumed that by this time farmers would have sufficient farming experience to grow intensive fresh and processed vegetable crops, which would allow the construction of vegetable processing and packing facilities.

Investment Capital - Enterprise Farm Approach

Total investment capital needed to develop the Irrigation Project under the fully integrated tribal enterprise farm approach will approximate $56.5 million (table 46). Of this total, $28.1 million will

Table 46. Total investments in machinery and equipment; marketing, processing and storage facilities; and infrastructure by number of acres developed for tribal enterprise farm, Navajo Indian Irrigation Project

Number Of Acres Developed	Machinery and Equipment	Packing Facilities	Processing Facilities	Storage Facilities	Livestock Facilities	Total Investment in Agricultural Equipment and Facilities	Infrastructure Investment	Total Investment
acres	. . . . . .thousand dollars.							
Startup							2,010	2,010
10,000	2,157	256		163	162	2,738	3,194	5,932
20,000	4,484	587		249	3,732	9,052	4,224	13,276
30,000	7,702	881		249	4,056	12,888	5,353	18,241
40,000	10,791	1,102	1,455	750	5,580	19,678	6,383	26,061
50,000	13,526	1,102	2,911	2,269	9,183	28,991	7,313	36,304
60,000	15,979	1,102	2,911	2,269	9,183	31,444	8,302	39,746
70,000	18,514	1,102	2,911	2,288	9,183	33,998	9,270	43,268
80,000	20,929	1,102	2,911	2,373	9,183	36,498	10,219	46,717
90,000	23,207	1,102	2,911	2,430	9,183	38,833	11,239	50,072
100,000	25,485	1,102	2,911	2,465	9,183	41,146	12,239	53,385
110,630	27,893	1,102	2,911	2,506	9,183	43,595	12,453	56,048
110,630 Fully Developed	28,120	1,102	2,911	2,506	9,183	43,822	12,667	56,489

be needed to purchase farm machinery and irrigation equipment. Infrastructure will require approximately $12.7 million. Infrastructure items budgeted for the tribal enterprise farm are seasonal labor housing, machinery repair shop, emergency health facility, and supply warehouse (table 47). Capital needed to construct facilities for livestock operations will total approximately $9.2 million. Livestock operations will include dairy, finish and backgrounding feedlots, laying hen operations, and a swine operation (table 48). The remaining $6.5 million will be needed to construct facilities for vegetable packing and processing, grain storage, and alfalfa seed processing (table 46).

Total investment requirements for the enterprise farm approach are relatively constant after the development of the fifth block of land (table 49). As with the small farm approach, most of the investment capital fluctuation occurs during the development of the fourth and fifth blocks of land. In the case of the enterprise farm, a substantial increase in investment capital requirements resulted with the construction of the various livestock facilities. These included additional feedlots and swine operations. The construction of these facilities accounted for over $3.5 million of investment during the development of the fifth block (table 49).

Investment Capital - Comparisons

The development of the Irrigation Project under the integrated tribal enterprise farm will require approximately $56.5 million compared to $50.4 million under the individually operated 320-acre farm approach. The reason for the higher investment with the tribal enterprise

Table 47. Estimated cost of constructing and maintaining infrastructure elements, by number of acres developed, for the tribal enterprise farm, Navajo Indian Irrigation Project

Item	Number of Acres Developed (Thousand Acres)											
	Startup	10	20	30	40	50	60	70	80	90	100	110
	thousand dollars											
Fire Station												
Construction[1]	32											
Depreciation and maintenance		3	3	3	3	3	3	3	3	3	3	3
Housing												
Supervision												
Construction[2]	45	45	45	45	45	45	45	45	45	45	45	
Maintenance[3]		2	5	7	9	11	14	16	18	20	23	26
Depreciation[4]		2	5	7	9	11	14	16	18	20	23	26
Administration												
Construction[2]	65	65										
Maintenance[3]		3	7	7	7	7	7	7	7	7	7	7
Depreciation[4]		3	3	7	7	7	7	7	7	7	7	7
Seasonal												
Construction[2]	260	260	260	260	260	260	260	260	260	260	260	
Maintenance[3]		13	26	39	52	65	78	91	104	117	130	143
Depreciation[4]		13	26	39	52	65	78	91	104	117	130	143
Repair Shop[5]												
Base												
Construction	100	100	100	100	100							
Maintenance[3]		5	10	15	20	25	30	30	30	30	30	30
Depreciation[4]		5	10	15	25	30	30	30	30	30	30	30
Sub-base												
Construction			80	20	20	20	20	20	20	20	20	20
Maintenance[3]			4	5	6	7	8	9	10	11	12	13
Depreciation[4]				4	5	6	7	8	9	10	11	12
Warehouse												
Construction[5]	50	50	50	50								
Maintenance[3]		5	8	10	10	10	10	10	10	10	10	10
Depreciation[4]		3	5	8	10	10	10	10	10	10	10	10
Emergency Facility												
Construction[6]	80	80										
Maintenance[3]		4	8	8	8	8	8	8	8	8	8	8
Depreciation[4]		4	8	8	8	8	8	8	8	8	8	8
Operating		60	65	70	75	80	85	90	95	100	100	100
Electricity												
Construction[7]	65	65	65	65	65	65	65	65	65	65	65	
Maintenance[3]		3	7	10	13	16	20	23	26	29	33	36
Water System												
Construction[7]	502	272	272	272	272	272	272	272	272	272	272	
Maintenance[3]		25	39	52	66	79	93	107	120	134	147	160
Depreciation[4]		33	52	70	88	106	124	142	160	178	196	214
Sewage Disposal System												
Construction[8]	410											
Maintenance[3]		21	21	21	21	21	21	21	21	21	21	21
Depreciation[4]		21	21	21	21	21	21	21	21	21	21	21
Vehicles[9]												
Purchase	66	50	66	149	116	116	182	165	149	208	191	178
Maintenance[3]	30	53	120	150	173	188	210	225	237	249	263	267
Depreciation[4]		22	39	39	72	88	77	99	116	105	119	133
Office Supplies	2	2	3	3	4	4	5	5	6	6	7	7
Infrastructure Salaries		72	115	180	223	295	324	338	360	374	389	403
Sub-total	1,675	1,364	1,548	1,759	1,865	1,949	2,136	2,242	2,349	2,495	2,591	2,036
Contingency Factor (20%)	335	273	310	352	373	390	427	448	470	499	518	407
Total	2,010	1,637	1,858	2,111	2,238	2,339	2,563	2,690	2,819	2,994	3,109	2,443

1 Cost information furnished by New Mexico State University Physical Plant.
2 Cost for housing was developed by project team based on current construction costs.
3 All maintenance is based on five percent of original investment, except for vehicles.
4 Depreciation based on straight-line method over 20 years with no salvage value, except for vehicles. Vehicles are depreciated over three years.
5 Cost for repair shops, base and sub-base, and warehouses were developed by project team members based on recommendations from large farming enterprises in California and Arizona.
6 Cost for emergency facility furnished by Public Health Division of Health and Social Services Department in Santa Fe, New Mexico.
7 Basic cost information furnished by Navajo Tribal Utility Authority.
8 Cost information developed by project team on recommendations from construction firm and Bureau of Indian Affairs.
9 Vehicles furnished for all management and supervisory personnel, except for general labor supervisors.

Table 48. Initial investment requirements for livestock producing facilities on the tribal enterprise farm, Navajo Indian Irrigation Project

Facility	Size	Number of Units	Investment
			dollars
Egg	300,000 layer[1]	1	1,750,000
Dairy	1,104 cow[1]	1	1,668,528
Swine	600 sow[1]	4	1,503,120
Backgrounding feedlot	5,000 head	6	970,950
Feedlot	15,000 head	4	3,300,000
Total			9,182,598

1 Includes investment in livestock.

Table 49. Investments in machinery and equipment; marketing, processing, and storage facilities; and infrastructure for each additional block of land developed for tribal enterprise farm, Navajo Indian Irrigation Project

Number of Acres Developed	Machinery and Equipment	Packing Facilities	Processing Facilities	Grain Storage Facilities	Livestock Facilities	Total Investment in Agricultural Equipment and Facilities	Infrastructure Investment	Total Investment
acres	thousand dollars							
Startup							2,010	2,010
Block 1[1]	2,157	256		163	162	2,738	1,184	3,922
Block 2	2,327	331		86	3,570	6,314	1,030	7,344
Block 3	3,218	294		0	324	3,836	1,129	4,965
Block 4	3,089	221	1,455	501	1,524	6,790	1,030	7,820
Block 5	2,735	0	1,456	1,519	3,603	9,313	930	10,243
Block 6	2,453	0	0	0	0	2,453	989	3,442
Block 7	2,535	0	0	19	0	2,554	968	3,522
Block 8	2,415	0	0	85	0	2,500	949	3,449
Block 9	2,278	0	0	57	0	2,335	1,020	3,355
Block 10	2,278	0	0	35	0	2,313	1,000	3,313
Block 11	1,408	0	0	41	0	2,449	214	2,663

1 Each block represents approximately 10,000 acres.

farm is the addition of several large scale livestock facilities such as feedlots, swine units, dairy, and laying hen houses. These investments totaled over nine million dollars with most of the facilities scheduled for construction during the second, fourth, and fifth development periods.

The individually operated farms will require an addition four million dollars for infrastructure investments in comparison to the enterprise farm. The need for 345 homesteads or a homestead per operator ($15,000 per farm) and the utility network to service these homesteads will require a substantial investment. The enterprise farm will not require this large number of facilities because individual homes will not be dispersed across the land. Investment in housing facilities for seasonal labor was budgeted for the enterprise farm under the assumption that it would be centrally located so the utility network would not become too complex. Investment in housing for permanent employees of the enterprise farm was not budgeted because it was assumed the individuals would utilize housing in the adjacent communities. Housing of seasonal labor was not included in the investment budgets for the individual farm approach. The amount of seasonal labor hired by individual farmers will depend upon the number of hours the operator is willing to work and the availability of family labor. Support functions such as repairs and maintenance centers would be strategically located throughout the project lands.

Operating Capital - 320-Acre Farm Approach

The Navajo Irrigation Project developed under the individually operated 320-acre farm approach will need approximately $32.3 million of operating capital to perform all direct and indirect farm activities (table 50).

Table 50. Total operating capital requirements for individual farms and related packing, processing, and custom services,and infrastructure, Navajo Indian Irrigation Project

Number of Acres Developed	Direct Farms	Packing, Processing, and Custom Services	Infrastructure	Total for Project
	. . . . . .thousand dollars.			
Startup	0	0	158	158
10,000	1,792	405	279	2,476
20,000	3,377	1,092	367	4,836
30,000	5,686	2,618	438	8,742
40,000	7,561	8,257	473	16,291
50,000	9,309	12,903	525	22,737
60,000	10,995	12,993	559	24,547
70,000	12,664	13,082	594	26,340
80,000	14,354	13,178	629	28,161
90,000	15,805	13,239	665	29,709
100,000	17,165	13,276	701	31,142
110,630	18,216	13,339	737	32,292
110,630 Fully Developed	18,217	13,338	737	32,292

Over 50 percent of this amount will be needed for direct farm activities such as the purchase of farm inputs including seed, fertilizer, fuel, insecticides, feed, labor, and other items. This amount calculated on a per farm basis means that approximately $53,000 will be needed annually by each individual farm operator to finance all direct farm activities (table 51). Individual farm operating capital requirements are predicted to be the highest during the third and fourth development periods because individual farmers are scheduled to begin growing more intensive vegetable crops during the periods, and as mentioned earlier, it was assumed that production costs would be abnormally high during the initial growing periods.

Estimated annual operating capital requirements for packing, processing, and custom activities to service the individual farms will total $13.3 million for the fully developed Project (table 50). This capital will be used for the expenses of operating these facilities including labor, packaging materials, machine parts, and other items. These indirect farming activities will not require a substantial amount of capital until the development of the fourth and fifth blocks of land. These activities will need $8.3 and $12.9 million during those periods (table 50). The sharp increase in operating capital requirements is again attributed to the establishment of packing and processing facilities needed for the increased production of vegetable crops.

Annual infrastructure operating capital requirements for the fully developed Project is projected to amount to $737,000 (table 50). Requirements for infrastructure increase as additional land is developed, although the increases are more substantial in the first, second, and third development periods than in latter periods. The establishment of basic facilities are

Table 51. Direct farm and indirect farm operating capital requirements by number of acres developed for the Navajo Indian Irrigation Project on the basis of 320-acre farms

Number of Acres Developed	Number of Farms	Direct Farm		Indirect Farm		
		Per Farm	Total	Packing, Processing and Custom Services	Infrastructure	Total
		(Nearest dollar)		thousand dollars		
Start-up	0	0	0	0	158	158
10,000	31	57,806	1,792	405	279	684
20,000	62	54,468	3,377	1,092	367	1,459
30,000	93	61,140	5,686	2,618	438	3,056
40,000	125	60,488	7,561	8,257	473	8,730
50,000	156	59,673	9,309	12,903	525	13,428
60,000	187	58,797	10,995	12,993	559	13,552
70,000	218	58,092	12,664	13,082	594	13,676
80,000	250	57,416	14,354	13,178	629	13,807
90,000	281	56,246	15,805	13,239	665	13,904
100,000	312	55,016	17,165	13,276	701	13,977
110,630	345	52,788	18,216	13,339	737	14,076
110,630 Fully Developed	345	52,803	18,217	13,338	737	14,075

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necessary as soon as possible, therefore, annual increases in the cost of operating and maintaining this equipment are greater at the onset (table 51).

Operating Capital - Enterprise Farm Approach

Total annual operating capital requirements for the fully developed Irrigation Project under the integrated enterprise farm will approximate $43.6 million (table 52). Approximately $15.3 million would be necessary for financing crop production activities including labor, fuel, seed, and others. Another $17.5 million would be needed to purchase cattle and feed, and other inputs for the livestock activities. The purchase of materials, electricity, labor, and other items for the cannery accounted for $6.9 million.

Annual operating capital requirements increased substantially during the fourth and fifth development periods. The increased acreage in vegetable crops,which are labor and capital intensive,caused the operating capital requirements to double for crop production during the fourth development period. The establishment of the processing facilities created a need for $3.45 million in operating capital during the same period.

Livestock activities require a substantial amount of annual operating capital to finance purchases of feed and replacement livestock. These factors resulted in increasing the annual operating capital requirements over $14 million from the third to the fifth development periods (table 52).

Operating Capital - Comparisons

The tribal enterprise farm is budgeted to need $11 million more annual operating capital than the small farms. The big difference

Table 52. Operating capital requirements for crop, livestock, and grain storage activities; packing and processing facilities; and infrastructure for each additional block of land developed for the tribal enterprise farm, Navajo Indian Irrigation Project

Number of Acres Developed	Production and Grain Storage Activities	Packing Shed	Processing	Livestock	Total Agricultural Enterprises	Infrastructure	Total Project
acres	thousand dollars						
Startup						32	32
10,000	1,055	266		746	2,067	270	2,337
20,000	2,422	644		1,731	4,797	440	5,237
30,000	4,656	1,451		3,223	9,330	579	9,909
40,000	8,431	2,145	3,451	7,925	21,952	689	22,641
50,000	15,341	2,145	6,902	17,554	41,942	818	42,760
60,000	16,060	2,145	6,902	17,554	42,661	915	43,576
70,000	16,728	2,145	6,902	17,554	43,329	982	44,311
80,000	16,743	2,145	6,902	17,554	43,344	1,054	44,398
90,000	16,551	2,145	6,902	17,554	43,152	1,118	44,270
100,000	16,276	2,145	6,902	17,554	42,877	1,182	44,059
110,630	15,985	2,145	6,902	17,554	42,586	1,233	43,819
110,630 Fully Developed	15,815	2,145	6,902	17,554	42,416	1,233	43,649

is the result of the substantial operating capital needs of the livestock enterprises budgeted for the tribal enterprise farm. The two approaches are similar in annual operating capital required for other activities.

Increases in annual operating capital requirements are very significant during the development of the third and fourth blocks of land for both approaches. These increases were caused by the greatly increased production and processing of labor and capital intensive vegetable crops.

EMPLOYMENT CREATED AND TRAINING NEEDS

The Navajo Indian Irrigation Project will create numerous full-time and seasonal employment opportunities for Navajos who are non-employed or underemployed. Various skill levels will be required for these new positions. Not enough Navajos with many of these skill levels are available, and therefore many will have to be trained. Planning and conducting the training program are vitally important to the success of the Irrigation Project. Estimates of the number of individuals required in specific occupations and estimates of when these individuals will be needed will be necessary to those involved in planning. This section is not intended to describe and make recommendations on alternative methods of accomplishing the training function.

The number of people needed by types of employment activities and by number of acres developed for both organizational approaches is discussed in this section. Seasonal labor requirements are also indicated by type of employment activity by development period. This section only

includes employment estimates of on-project activities. Estimates of secondary employment or off-project activities such as gasoline stations, department stores, and others are not included, but it is anticipated that the expansion of these businesses, as a direct result of the Irrigation Project, will also create many employment opportunities.

Employment by Type of Activity - 320-Acre Farm Approach

Four basic types of job activities will prevail on the Irrigation Project if developed on the basis of 320-acre farms. These are direct farming, custom services, processing, and infrastructure (table 53).

Direct Farming. Direct farming operations will create the need for individual farm operators and hired farm laborers. The need for this group will increase with the development of each block of land. A group of 31 farm operators would have to be trained prior to the development of the initial 10,000-acre block of land, and this number will increase to 345 farm operators upon complete development of the 110,000-acre Project (table 54). Farm laborers will be needed to help the individual farm operators during the busy seasons. A maximum of 52 farm laborers will be needed during development of the first block; however, by the time the Project is fully developed,over 900 farm laborers will be needed during the peak period. The seasonal labor may be hired from off the farm or could possibly consist of family labor.

Training operators capable of managing a commercial farm will present a challenge. A successful farm manager must have proficiency in buying, selling, planning, decision making, equipment operation, and

Table 53. Estimated number of full-time jobs created by farming, custom service, processing, and infrastructure operations by seasonal period and number of acres developed, as a result of individually operated 320-acre farms, Navajo Indian Irrigation Project

Number of Acres Developed	Type of Operation	Period			
		Dec.-Mar.	Apr.-May	June-Aug.	Sept.-Nov.
		number of individuals			
10,000	Farming[1]	31	62	83	31
	Custom service[2]	1	5	49	44
	Infrastructure	13	13	13	13
	Total	45	80	145	88
20,000	Farming[1]	62	177	220	62
	Custom service[2]	1	9	97	193
	Infrastructure	17	17	17	17
	Total	80	203	334	272
30,000	Farming[1]	96	347	327	93
	Custom service[2]	0	8	490	427
	Infrastructure	21	21	21	21
	Total	117	376	838	541
40,000	Farming[1]	129	436	418	125
	Custom service[2]	0	17	915	480
	Processing[2]	49	71	144	150
	Infrastructure	24	24	24	24
	Total	202	548	1,501	779
50,000	Farming[1]	161	513	521	156
	Custom service[2]	0	26	938	581
	Processing[2]	99	142	289	300
	Infrastructure	24	24	24	26
	Total	284	705	1,772	1,063
60,000	Farming[1]	192	595	620	187
	Custom service[2]	0	26	934	581
	Processing[2]	99	142	289	300
	Infrastructure	26	26	26	26
	Total	317	789	1,869	1,094
70,000	Farming[1]	223	691	737	218
	Custom service[2]	0	26	933	625
	Processing[2]	99	142	289	300
	Infrastructure	26	26	26	26
	Total	348	885	1,985	1,169
80,000	Farming[1]	254	792	858	250
	Custom service[2]	1	26	934	670
	Processing[2]	99	142	289	300
	Infrastructure	26	26	26	26
	Total	380	986	2,107	1,246
90,000	Farming[1]	281	883	974	281
	Custom service[2]	1	28	944	684
	Processing[2]	99	142	289	300
	Infrastructure	26	26	26	26
	Total	407	1,079	2,233	1,291
100,000	Farming[1]	312	954	1,077	312
	Custom service[2]	2	29	956	686
	Processing[2]	99	142	289	300
	Infrastructure	26	26	26	26
	Total	439	1,151	2,348	1,324
110,630	Farming[1]	345	1,032	1,200	345
	Custom service[2]	3	32	962	698
	Processing[2]	99	142	289	300
	Infrastructure	26	26	26	26
	Total	473	1,232	2,477	1,369
110,630 Fully Developed	Farming[1]	345	1,085	1,255	345
	Custom service[2]	3	32	962	697
	Processing[2]	99	142	289	300
	Infrastructure	26	26	26	26
	Total	473	1,285	2,532	1,368

1 Includes farm operator and hired labor.
2 Based on 40-hour work week per full-time man equivalent.

Table 54. Number of farm operators and hired labor required by periods and by number of acres developed for individually operated 320-acre farms, Navajo Indian Irrigation Project

Number of Acres Developed	Labor Category	Period			
		Dec.-Mar.	Apr.-May	June-Aug.	Sept.-Nov.
		number of individuals[1]			
10,000	Farm operator	31	31	31	31
	Hired labor	0	31	52	0
20,000	Farm operator	62	62	62	62
	Hired labor	0	115	158	0
30,000	Farm operator	93	93	93	93
	Hired labor	3	254	234	0
40,000	Farm operator	125	125	125	125
	Hired labor	4	311	293	0
50,000	Farm operator	156	156	156	156
	Hired labor	5	357	365	0
60,000	Farm operator	187	187	187	187
	Hired labor	5	408	433	0
70,000	Farm operator	218	218	218	218
	Hired labor	5	473	519	0
80,000	Farm operator	250	250	250	250
	Hired labor	4	542	608	0
90,000	Farm operator	281	281	281	281
	Hired labor	0	602	693	0
100,000	Farm operator	312	312	312	312
	Hired labor	0	642	765	0
110,630	Farm operator	345	345	345	345
	Hired labor	0	687	855	0
110,630 Fully Developed	Farm operator	345	345	345	345
	Hired labor	0	740	910	0

1 Based on a 40-hour work week.

knowledge of the cultural practices for the crops being grown. Essentials of equipment operation and cultural practices can readily be taught. It is much more difficult to teach topics such as financial planning and decision making.

Custom Service. Custom service activities, which include custom farm machinery operations, packing shed operations, and other indirect farm activities, will create numerous seasonal employment opportunities. There will be a need for 49 people trained for employment in custom service activities during the peak work period,June through August,during the first development period (table 53). This number will increase to 915 by the fourth development period. This substantial increase in custom service employment is due to the additional acreage of land as well as the addition of labor intensive vegetable crops to the farming activities. Total peak season custom service employment for the fully developed Project on the basis of 320-acre farms was estimated to be 962. Skill levels needed for employment in custom service activities varies widely,but there will be a need for trained equipment operators, foremen and supervisors, and semi to unskilled general laborers.

Processing. Vegetable processing activities will create more full-time year-round jobs than custom services (table 53). Processing activities also create additional job opportunities during the peak seasonal labor demand period. The vegetable cannery will not be in operation until the fourth development period and will require a seasonal minimum of 49 employees and a maximum of 150 in its first year of operation. The minimum number will increase to 99 and the maximum number will increase to 300 during the fifth

development period as capacity is increased. Employment in processing will remain constant for the duration of the Project development at the level achieved during the fifth development period. The vegetable processing industry will create a need for individuals trained in processing line supervision, equipment operation, maintenance, and warehousing.

Infrastructure. Infrastructure associated with development on the basis of 320-acre farms will create a small number of full-time jobs. Jobs created will require trained agricultural specialists to perform extension work, secretaries, plumbers, carpenters, welders, mechanics, and other trade skills. Infrastructure during the first development period will create employment for 13 individuals. The expected number of jobs created will double by the time the Project is fully developed.

Employment by Type of Activity - Enterprise Farm Approach

The integrated tribal enterprise farm approach will also create employment in four general basic activities. These include: 1) farming, 2) packing, processing, and storage, 3) livestock, and 4) infrastructure (table 55).

Direct farming. Direct farming operations will create numerous job opportunities for field laborers, machine operators, and irrigators (table 56). Of these, machine operators will be the most highly skilled and require the most training. Most of the direct farming work will be seasonal in nature, although employment needs do not fluctuate as much as in some non-direct farming activities such as packing, processing, and storage operations. A minimum of 13 individuals will be needed to perform

Table 55. Employment created by type of operation, seasonal labor period, and number of acres developed under the tribal enterprise farm approach, Navajo Indian Irrigation Project

Number of Acres Developed	Type of Operations	Period: Dec.-Mar.	Apr.-May	June-Aug.	Sept.-Nov.
		number of individuals[1]			
10,000	Farming	13	69	90	63
	Packing, processing, and storage	3	3	22	59
	Livestock	12	0	0	5
	Infrastructure	19	19	19	19
	Total	47	91	131	146
20,000	Farming	21	164	225	189
	Packing, processing, and storage	3	3	38	145
	Livestock	92	67	67	75
	Infrastructure	31	31	31	31
	Total	147	265	361	440
30,000	Farming	40	293	398	381
	Packing, processing, and storage	3	3	317	182
	Livestock	118	71	71	86
	Infrastructure	45	45	45	45
	Total	206	412	831	694
40,000	Farming	57	398	596	463
	Packing, processing, and storage	60	82	733	351
	Livestock	160	92	92	117
	Infrastructure	56	56	56	56
	Total	333	628	1,477	987
50,000	Farming	69	444	656	521
	Packing, processing, and storage	126	170	873	515
	Livestock	247	183	183	204
	Infrastructure	70	70	70	70
	Total	512	867	1,782	1,310
60,000	Farming	80	493	702	584
	Packing, processing, and storage	126	172	875	513
	Livestock	245	181	181	203
	Infrastructure	74	74	74	74
	Total	525	920	1,832	1,374
70,000	Farming	91	570	797	626
	Packing, processing, and storage	127	171	873	514
	Livestock	245	181	181	203
	Infrastructure	76	76	76	76
	Total	539	998	1,927	1,419
80,000	Farming	104	640	909	646
	Packing, processing, and storage	127	172	874	518
	Livestock	245	181	181	202
	Infrastructure	79	79	79	79
	Total	545	1,072	2,043	1,445
90,000	Farming	117	692	993	670
	Packing, processing, and storage	127	172	874	518
	Livestock	245	181	181	202
	Infrastructure	81	81	81	81
	Total	560	1,126	2,129	1,471
100,000	Farming	129	743	1,076	695
	Packing, processing, and storage	127	171	874	518
	Livestock	245	181	181	202
	Infrastructure	83	83	83	83
	Total	574	1,178	2,214	1,498
110,630	Farming	143	795	1,164	723
	Packing, processing, and storage	127	171	873	517
	Livestock	245	181	181	202
	Infrastructure	85	85	85	85
	Total	600	1,232	2,303	1,527
110,630 Fully Developed	Farming	144	830	1,212	718
	Packing, processing, and storage	126	170	872	516
	Livestock	245	181	181	202
	Infrastructure	85	85	85	85
	Total	600	1,266	2,350	1,521

1 Includes supervisory personnel.

Table 56. Employment created by type of work performed, seasonal labor period, and number of acres developed under the tribal enterprise farm approach, Navajo Indian Irrigation Project

Number of Acres Developed	Labor Category	Period			
		Dec.-Mar.	Apr.-May	June-Aug.	Sept.-Nov.
		number of individuals			
10,000	Field labor	0	27	9	9
	Machine	9	13	27	23
	Irrigation	2	20	40	21
	Grain storage	3	3	4	4
	Packing shed	0	0	18	55
	Feedlot	12	0	0	5
	Infrastructure	19	19	19	19
	Total	45	82	117	136
20,000	Field labor	1	52	28	97
	Machine	16	36	67	47
	Irrigation	2	59	103	26
	Grain storage	3	3	5	5
	Packing shed	0	0	33	140
	Laying hen	36	36	36	36
	Dairy	31	31	31	31
	Feedlot	25	0	0	8
	Infrastructure	31	31	31	31
	Total	145	248	334	421
30,000	Field labor	1	46	88	174
	Machine	29	103	132	154
	Irrigation	6	117	142	19
	Grain storage	3	3	4	4
	Packing shed	0	0	313	178
	Laying hen	34	34	34	34
	Dairy	37	37	37	37
	Feedlot	47	0	0	15
	Infrastructure	45	45	45	45
	Total	202	385	795	660
40,000	Field labor	2	59	158	188
	Machine	42	149	213	224
	Irrigation	8	161	180	18
	Grain storage	9	9	14	15
	Packing shed	0	0	568	179
	Cannery	51	73	151	157
	Laying hen	31	31	31	31
	Dairy	26	26	26	26
	Swine	8	8	8	8
	Feedlot	95	27	27	52
	Infrastructure	56	56	56	56
	Total	328	599	1,432	954
50,000	Field labor	3	66	170	188
	Machine	52	167	240	281
	Irrigation	10	183	206	22
	Grain storage	29	29	44	44
	Packing shed	0	0	540	172
	Cannery	97	141	289	299
	Laying hen	29	29	29	29
	Dairy	25	25	25	25
	Swine	26	26	26	26
	Feedlot	167	103	103	124
	Infrastructure	70	70	70	70
	Total	508	839	1,742	1,280
60,000	Field labor	3	63	168	188
	Machine	60	191	256	334
	Irrigation	12	209	236	29
	Grain storage	29	29	44	44
	Packing shed	0	0	540	170
	Cannery	97	143	291	299
	Laying hen	28	28	28	28
	Dairy	24	24	24	24
	Swine	26	26	26	26
	Feedlot	167	103	103	125
	Infrastructure	74	74	74	74
	Total	520	890	1,790	1,341

Table 56. continued

Number of Acres Developed	Labor Category	Period			
		Dec.-Mar.	Apr.-May	June-Aug.	Sept.-Nov.
		number of individuals			
70,000	Field labor	3	62	166	189
	Machine	69	222	289	367
	Irrigation	13	251	295	34
	Grain storage	29	29	44	44
	Packing shed	0	0	540	170
	Cannery	98	142	289	300
	Laying hen	28	28	28	28
	Dairy	24	24	24	24
	Swine	26	26	26	26
	Feedlot	167	103	103	125
	Infrastructure	76	76	76	76
	Total	533	963	1,880	1,383
80,000	Field labor	4	63	167	189
	Machine	81	247	323	374
	Irrigation	13	292	365	45
	Grain storage	30	30	45	45
	Packing shed	0	0	540	174
	Cannery	97	142	289	299
	Laying hen	28	28	28	28
	Dairy	24	24	24	24
	Swine	26	26	26	26
	Feedlot	167	103	103	124
	Infrastructure	79	79	79	79
	Total	539	1,034	1,989	1,407
90,000	Field labor	4	63	168	190
	Machine	93	265	349	381
	Irrigation	13	322	416	60
	Grain storage	30	30	45	45
	Packing shed	0	0	540	174
	Cannery	97	142	289	299
	Laying hen	28	28	28	28
	Dairy	24	24	24	24
	Swine	26	26	26	26
	Feedlot	167	103	103	124
	Infrastructure	81	81	81	81
	Total	553	1,084	2,069	1,432
100,000	Field labor	4	63	169	191
	Machine	104	283	374	388
	Irrigation	13	352	468	75
	Grain storage	30	30	45	45
	Packing shed	0	0	540	174
	Cannery	97	141	289	299
	Laying hen	28	28	28	28
	Dairy	24	24	24	24
	Swine	26	26	26	26
	Feedlot	167	103	103	124
	Infrastructure	83	83	83	83
	Total	566	1,133	2,149	1,457
110,630	Field labor	5	63	170	193
	Machine	116	302	401	396
	Irrigation	13	382	522	91
	Grain storage	30	29	45	45
	Packing shed	0	0	540	174
	Cannery	97	142	288	298
	Laying hen	28	28	28	28
	Dairy	24	24	24	24
	Swine	26	26	26	26
	Feedlot	167	103	103	124
	Infrastructure	85	85	85	85
	Total	591	1,184	2,232	1,484
110,630 Fully Developed	Field labor	5	63	171	194
	Machine	117	314	416	395
	Irrigation	13	402	551	86
	Grain storage	29	28	43	43
	Packing shed	0	0	540	174
	Cannery	97	142	289	299
	Laying hen	28	28	28	28
	Dairy	24	24	24	24
	Swine	26	26	26	26
	Feedlot	167	103	103	124
	Infrastructure	85	85	85	85
	Total	591	1,215	2,276	1,478

farming activities on the first block of land, but during the peak time of activity the need will increase to 90 individuals. Employment in direct farming for the fully developed Project will fluctuate from a minimum of 144 individuals to a maximum of 1,212 individuals.

Effective employment of a substantial number of people in direct farming activities creates numerous supervisor positions (table 57). Supervisors will be needed to plan, coordinate, and control the activities of machine operators, irrigators, and field labor crews. The number of supervisor positions created in direct farming will vary from a seasonal low of 2 to a seasonal high of 14 for the first 10,000-acre block. Employment of supervisors will range seasonally from a low of 9 to a maximum of 74 for the fully developed project. Supervisors will need to be trained in technical skills and human administrative skills.

Packing, processing, and storage. Jobs in fresh vegetable packing, vegetable processing, and grain storage activities are more seasonal than the farming activity needs (table 55). This is particularly true for fresh vegetable packing employment. A maximum of 59 people would be employed in these activities from September through November during the development of the first block of land. However, by the fifth development period, these activities create in excess of 870 jobs. Employment in these activities remains constant from the fifth development period through the duration of the development of the Project lands. Training in equipment operation, maintenance, supervision, and warehousing will be needed to provide productive employees for these activities.

Table 57. Estimated number and type of supervisors required for farming activity by seasonal period and number of acres developed for tribal enterprise farm, Navajo Indian Irrigation Project

Number of Acres Developed	Type of Supervisor	Period			
		Dec.-Mar.	Apr.-May	June-Aug.	Sept.-Nov.
		number of supervisors			
10,000[1]	Machine operator	2	3	5	5
	Irrigation	0	4	8	4
	Field labor	0	2	1	1
	Total	2	9	14	10
20,000[2]	Machine operator	2	5	10	7
	Irrigation	0	8	15	4
	Field labor	0	4	2	8
	Total	2	17	27	19
30,000[3]	Machine operator	3	11	15	17
	Irrigation	1	12	14	2
	Field labor	0	4	7	15
	Total	4	27	36	34
40,000[4]	Machine operator	4	12	18	19
	Irrigation	1	13	15	2
	Field labor	0	4	12	12
	Total	5	29	45	33
50,000[5]	Machine operator	3	12	17	19
	Irrigation	1	13	14	2
	Field labor	0	3	9	9
	Total	4	28	40	30
60,000[5]	Machine operator	4	13	17	22
	Irrigation	1	14	16	2
	Field labor	0	3	9	9
	Total	5	30	42	33
70,000[5]	Machine operator	5	15	19	24
	Irrigation	1	17	20	2
	Field labor	0	3	8	10
	Total	6	35	47	36
80,000[5]	Machine operator	5	16	22	25
	Irrigation	1	19	24	3
	Field labor	0	3	8	10
	Total	6	38	54	38
90,000[5]	Machine operator	6	18	23	25
	Irrigation	1	21	28	4
	Field labor	0	3	9	10
	Total	7	42	60	39
100,000[5]	Machine operator	7	19	25	26
	Irrigation	1	23	31	5
	Field labor	0	3	9	10
	Total	8	45	65	41
110,630[5]	Machine operator	8	20	27	27
	Irrigation	1	25	35	6
	Field labor	0	3	9	10
	Total	9	48	71	43
110,630 Fully developed[5]	Machine operator	8	21	28	27
	Irrigation	1	27	37	6
	Field labor	0	3	9	10
	Total	9	51	74	43

1 Based on one supervisor per five irrigators and machine operators, and one supervisor per 12 field laborers.
2 Based on one supervisor per seven irrigators and machine operators, and one supervisor per 12 field laborers.
3 Based on one supervisor per ten irrigators, nine machine operators, and 15 field laborers.
4 Based on one supervisor per 12 irrigators, 12 machine operators, and 15 field laborers.
5 Based on one supervisor per 15 irrigators, 15 machine operators, and 20 field laborers.

Livestock. Livestock activities such as the dairy, laying hen, feedlot, and swine operations retain a rather stable number of employees the year-round because of the continuous nature of these activities (table 56). Employment in livestock activities does not begin until the development of the second block of land at which time a seasonal minimum of 67 jobs will be created. Minimum seasonal employment will increase to 183 and a maximum seasonal employment of 247 with development of the fifth block of land, and then will remain constant through the duration of the Project development.

Most of the livestock activities will require a few highly trained, experienced individuals to be profitable operations. Training for cowboys, swine herdsmen, feeders, and mill operators will be needed.

Infrastructure. Infrastructure on the enterprise farm will create a rather small number of skilled jobs, but they will be full-time year-round employment (table 55). These activities will create a demand for electricians, mechanics, welders, carpenters, plumbers, secretaries, and other skilled individuals who will provide support to the farming, livestock, processing, and storage operations. A minimum of 19 individuals are estimated to be needed for the initial block of land; however, infrastructure jobs will increase gradually until they reach a maximum of 85 during the eleventh development period.

Managers. An estimated 97 full-time managerial positions will be created with the full development of the tribal enterprise farm (table 58). It is estimated that 17 full-time managerial positions will be created with development of the first 10,000-acre block. Managerial positions will include a

Table 58. Number of management personnel required by number of acres developed for tribal enterprise farm, Navajo Indian Irrigation Project

Number of Acres Developed	Number of Management Personnel[1]
10,000	17
20,000	23
30,000	44
40,000	59
50,000	74
60,000	79
70,000	89
80,000	91
90,000	93
100,000	95
110,630	97
110,630 Fully Developed	97

1 Top management positions including general manager, office manager, personnel director, director of crop production, production superintendents, and others.

general manager, office manager, personnel director, manager of crop production, production superintendents, marketing managers, and many others. Many of these positions will require college level training and experience with other business firms.

Employment by Season

The previous section included employment created by type of activity stressing minimum and maximum number of jobs created and training needs. The reason for the substantial seasonal variation in employment for both organizational approaches is discussed in this section.

There were four labor periods used in this study. These were: 1) December through March, 2) April through May, 3) June through August, and 4) September through November. These seasonal periods were selected because of the similarity and intensity of the cultural, harvesting, packing, and processing activities normally performed during these months. December through March represents the low activity season for both farm organizational approaches. Most direct farming activities during this period are generally limited to th preplant or tillage operations such as plowing and disking which do not create employment for a large number of individuals. Employment in the livestock operations does not significally drop during the December through March season because these activities generally require a constant number of individuals the year-round.

April through May is the season when many crops are being planted and irrigated. The spring season is usually a critical period when almost all crops must be planted as quickly as possible, therefore, a need for several machine operators is created (table 56). Irrigation is also a major

activity during this time, thereby creating a substantial number of jobs for irrigators.

June through August represents the peak employment season with both organizational approaches. Farming, custom service, processing, packing, and storage activities are all being performed. Some fresh vegetables are hand-harvested, thereby increasing the number of field laborers needed as well as creating employment in the fresh vegetable packing shed. Other vegetable and field crops are also being irrigated and harvested, further creating numerous jobs.

September through November is still a very active season for both direct farming and indirect farming operations. The activities performed during this season are continuations of those performed in the previous season except they will not require the peak employment levels maintained during June, July, and August.

Seasonal variation in employment using December through March as the base period for both organizational approaches is shown in table 59. It is evident that employment fluctuates considerably more for the 320-acre farm approach than the tribal enterprise farm development approach. The individual farm operators, during the low employment season, can perform all their farming operations, and therefore, will not need hired labor. The enterprise farm must keep key management and supervisory people on the payroll on a year-round basis in order to retain them. However, the greater number of people employed in livestock activities is the principal reason the enterprise farm exhibits substantially less seasonal variation in employment.

Table 59. Seasonal variation in employment measured as a percent of full-time employment during the December through March period for individual farm development and tribal enterprise farm, Navajo Indian Irrigation Project

Number of Acres Developed	Tribal Enterprise Farm				320-Acre Farms			
	Dec.-Mar.	Apr.-May	June-Aug.	Sept.-Nov.	Dec.-Mar.	Apr.-May	June.-Aug.	Sept.-Nov.
	percent of base period							
10,000	100	169	231	255	100	178	322	196
20,000	100	169	226	272	100	254	418	340
30,000	100	182	350	295	100	321	716	462
40,000	100	175	392	267	100	271	743	386
50,000	100	161	317	236	100	248	624	374
60,000	100	165	316	241	100	249	590	345
70,000	100	173	321	240	100	254	570	336
80,000	100	183	336	242	100	259	554	328
90,000	100	187	340	240	100	265	549	317
100,000	100	190	345	238	100	262	535	302
110,630	100	191	344	233	100	260	524	289
110,630 Fully Developed	100	196	351	232	100	272	535	289

Total Employment - Comparisons

The previous section included the seasonal variation in employment for both approaches, but these variations did not reveal total numbers involved for all types of activities. Total employment created by season and by number of acres developed is discussed in this section.

It is evident that the enterprise farm approach will maintain a larger work force during the low employment season, December through March (table 60). The reason for the additional 224 employees on the enterprise farm is accounted for by the additional employment created by the livestock operations as well as the management and supervisory needs of the enterprise farm.

Employment created during the peak labor season, June through August, is similar for both organizational approaches through the entire Project development.

For purposes of comparing total employment, jobs created by season were converted to man-year equivalents for both organizational approaches (table 61). A man-year equivalent was defined as 12 months of full-time employment, but it does not mean any one individual is guaranteed year-round employment. Two individuals employed full-time from June 1 through November 30 would equal one man-year equivalent. Estimates of man-year equivalents were arrived at by totaling the number of individuals fully employed for each month of the year and dividing by 12. The enterprise farm will create approximately 1,476 man-year equivalents in employment upon completion of the development. This is approximately 130 more man-year equivalents than created with the individual farm development approach.

Table 60. Total employment created by direct farm, indirect farm, and infrastructure activities for tribal enterprise farm and 320-acre individually operated farms, Navajo Indian Irrigation Project

Number of Acres Developed	Period							
	Dec.-Mar.		Apr.-May		June-Aug.		Sept.-Nov.	
	Tribal enterprise farm	320-acre farm	Tribal enterprise farm	320-acre farm	Tribal enterprise farm	320-acre farm	Tribal enterprise farm	320-acre farm
	..... number of individuals							
10,000	64	45	108	80	148	145	163	88
20,000	170	80	288	203	384	334	463	272
30,000	250	117	456	376	875	838	738	541
40,000	392	202	687	548	1,536	1,501	1,046	779
50,000	586	284	941	705	1,856	1,772	1,384	1,063
60,000	604	317	999	789	1,911	1,869	1,453	1,094
70,000	628	348	1,087	885	2,016	1,985	1,508	1,169
80,000	636	380	1,163	986	2,134	2,107	1,536	1,246
90,000	653	407	1,219	1,079	2,222	2,233	1,564	1,291
100,000	669	439	1,273	1,151	2,309	2,348	1,593	1,324
110,630	697	473	1,329	1,232	2,400	2,477	1,624	1,369
110,630 Fully Developed	697	473	1,363	1,285	2,447	2,532	1,618	1,368

Table 61. Total employment created in man-year equivalents for tribal enterprise farm and individually operated farms by number of acres developed, Navajo Indian Irrigation Project

Number of Acres Developed	Tribal Enterprise Farm		320-Acre Farm[1]	
	man-months	man-years	man-months	man-years
10,000	1,405	117	1,039	87
20,000	2,797	316	2,544	212
30,000	6,751	563	5,357	446
40,000	10,688	891	8,744	729
50,000	13,946	1,162	11,051	921
60,000	14,506	1,209	11,735	978
70,000	15,258	1,272	12,624	1,052
80,000	15,880	1,323	13,551	1,129
90,000	16,408	1,367	14,358	1,196
100,000	16,928	1,411	15,074	1,256
110,630	17,518	1,460	15,894	1,324
110,630 Fully Developed	17,709	1,476	16,162	1,347

1 Includes employment created by indirect activities and infrastructure.

Capital Requirements per Man-Year Equivalent - Comparison

The previous sections included employment created by various activities for both organizational approaches. The functional relationship between the amount of capital needed to the amount of employment created is an important issue to the Navajo Tribe. The Tribe is short of capital resources and in need of additional employment. This section compares operating and investment capital required per man-year equivalent in employment created for each development period under both organizational approaches (table 62).

The 320-acre farm approach is predicted to require approximately $27,000 more total capital per man-year equivalent of employment created than the enterprise farm approach during development of the first block of land. This difference was caused by the substantial investment capital required for the individual farm approach during the initial development period, especially infrastructure investment and farming equipment. The employment created for the small farm approach was limited to farmers and some hired labor; therefore, the higher total investment caused investment per man-year equivalent to be substantially higher than for the enterprise farm.

The total investment capital requirements per man-year equivalent of employment decreased for both organizational approaches through the fourth development period, then increased during the fifth development period. This increase was greater for the enterprise farm because of the establishment of sizable operating capital-consuming livestock operations. These operations use more capital in relation to their employment capacity than direct farming activities and thus cause the enterprise farm to have higher capital requirements per man-year equivalent than the individual

Table 62. Total capital requirements per full-time man equivalent for individually operated 320-acre farms and tribal enterprise farm, Navajo Indian Irrigation Project

Number of Acres Developed	320-Acre Farms[1]				Tribal Enterprise Farm			
	Annual full-time man equivalents	Operating	Investment	Total	Annual full-time man equivalents	Operating	Investment	Total
	number	thousand dollars			number	thousand dollars		
10,000	87	28	70	98	117	20	51	71
20,000	212	23	49	72	316	17	42	59
30,000	446	20	35	55	563	18	32	50
40,000	729	22	30	52	891	25	29	54
50,000	921	25	30	55	1,162	37	31	68
60,000	978	25	28	53	1,209	36	33	69
70,000	1,052	25	24	49	1,272	35	34	69
80,000	1,129	25	35	60	1,323	34	35	69
90,000	1,196	25	37	62	1,367	32	37	69
100,000	1,256	25	38	63	1,411	31	38	69
110,630	1,324	24	38	62	1,460	30	38	68
110,630 Fully Developed	1,347	24	37	61	1,476	30	38	68

1 Includes employment numbers and investment capital required in performing custom services, packing, processing, and infrastructure.

farm approach. Elimination of livestock operations would decrease capital requirements considerably and lower the amount of capital needed per job created for the tribal enterprise farm approach; however, this action would reduce total employment created by approximately 20 percent and increase the seasonal variation in employment.

INCOME GENERATED

Several measures of income are important in considering the economic impact of developing the Irrigation Project on the Navajo Nation: 1) total labor income created; 2) total net income from farming, processing, and related service industries; 3) return on invested capital; and 4) ability to repay investment and operating capital loans at commercial interest rates.

These measures of income generated are discussed in this section for both farm organizational approaches. For purposes of estimating income and repayment capacity of the Project, it was assumed that all operating and investment capital would be borrowed. It was also assumed that the debt for investment capital would be retired over a reasonable period of years out of earnings in excess of interest charges. Operating capital needs were assumed to be in the form of a line of credit and be revolved on an annual basis. It was also assumed that interest would be paid at a 7 percent annual rate on operating capital and on the unpaid investment capital balance. The investment capital repayment schedule was derived on the basis of ability to repay and was based on a 25-year period with the first payment due at the end of the fifth year after the loan is made for developing each block

of land for the tribal enterprise farm. The direct farm investment portion of the 320-acre farms was also scheduled for a 25-year repayment plan with similar delayed principal repayment privileges. The capital repayment schedule for the indirect farm investments accompanying development of the individually operated 320-acre farms was based on a 30-year repayment plan with the first payment due at the end of the fifth year after the loan is made. This repayment plan was scheduled at 30 years because it was realized these indirect activities would not have the income earning potential at the prices budgeted to repay the loan over the shorter 25-year period.

Total project operating capital for financing farming activity was based on the summation of annual operating capital requirements for all crops scheduled for production. Interest was charged on an annual basis for the full operating capital needs. It is possible that operating capital for many crops would be needed for only a short period of time and could be utilized for more than one crop in any one year, thus reducing the estimated total operating capital needed. The accounting procedure used in this study tended to overestimate operating capital requirements and interest charges, thereby biasing net income downward. Operating capital requirements for the livestock activities were based on a cash flow procedure, and as a result, did not overestimate operating capital needs.

Labor Income

The Irrigation Project will generate income in the form of return to the owners of the capital resources and to the labor employed on the

Project. Estimated incomes received through employment created by development of the Irrigation Project on the basis of 320-acre farms and a tribal enterprise farm are discussed in this section.

320-Acre Farm Approach. Total annual labor income generated for the initial development block of the Irrigation Project is estimated at approximately $500,000 (table 63). This amount will increase to $4.61 million by the fifth development period. This increase is attributed to additional employment created by a five-fold increase in the number of farms and by vegetable packing and processing. Labor income increases only $1.5 million from the fifth through the final development period. Most of the off-farm activities such as packing and processing vegetables have attained peak employment levels by the fifth development period. Increase in labor income after the fifth period is mostly a result of increasing the number of farms.

Total annual labor income will reach $6.3 million by the end of the eleventh development period. Over 50 percent will be earned by individuals employed in the highly seasonal indirect farm custom activities. Direct farm labor will earn $2.63 million with only approximately $1.1 million going to individual farm operators for their labor, assuming they work only 40 hours per week and hire labor for requirements in excess of 40 hours per week. This averages about $3,200 of labor income for each of the 345 individual farm operators. However, if the farm operators are willing to work longer hours on the average and hire less part-time labor, they can increase their annual labor income.

Table 63. Estimated returns to direct and indirect labor for the 320-acre farm versus the tribal enterprise farm approach, Navajo Indian Irrigation Project

Number of Acres Developed	320-Acre Farms				Tribal Enterprise Farm		
	Direct[1]	Indirect[2]	Infra-structure	Total	Direct[3]	Infra-structure	Total
acres	thousand dollars						
10,000	187	159	155	501	472	121	593
20,000	422	473	192	1,087	1,611	164	1,775
30,000	729	1,257	222	2,208	3,032	229	3,261
40,000	964	2,437	222	3,623	5,026	272	5,298
50,000	1,211	3,163	236	4,610	6,497	301	6,798
60,000	1,425	3,226	236	4,887	6,782	379	7,161
70,000	1,660	3,288	236	5,184	7,173	393	7,566
80,000	1,904	3,355	236	5,495	7,588	429	8,017
90,000	2,127	3,394	236	5,757	7,925	443	8,368
100,000	2,320	3,417	236	5,973	8,262	458	8,720
110,630	2,554	3,449	236	6,239	8,612	472	9,084
110,630 Fully Developed	2,630	3,449	236	6,315	8,714	472	9,186

1 Includes all labor charged in the budgets and paid by the farm operator including return to his labor.
2 Include all labor associated with growing, packing, and processing crops performed on a custom basis by the Tribe for individual operators.
3 Includes all labor associated with growing, packing, and processing of crops under the tribal enterprise farm concept.

Tribal Enterprise Farm Approach. Total annual labor income for the first development block is estimated to be nearly $600,000 (table 63). This total increases to almost $6.8 million annually by the fifth development period. Employment created by processing and livestock operations accounted for the substantial increase in labor income. Labor income from the fifth through the final development period increases $2.4 million making a total of approximately $9.2 million annually for the fully developed Project.

Labor Income - Comparisons. Total annual labor income is estimated to be over $2.9 million greater for the tribal enterprise approach than for the individual farm approach when the Project is fully developed. Labor income for the enterprise farm increases substantially as livestock activities are added, particularly during the fourth and fifth development periods. Annual labor income for the livestock activities on the fully developed enterprise farm are estimated to be:

Dairy	$163,800
Layers (eggs)	156,000
Swine	257,880
Backgrounding feedlots	170,820
Finish feedlots	530,496
Total	$1,278,996

This compares to only $244,950 annual labor income from backgrounding calves, the only livestock activity on the individual farms.[4]

The tribal enterprise farm, because of its use of large efficient machinery and equipment, attains a higher degree of efficiency in direct labor use than the individually operated farms. However, to plan, coordinate, and supervise the direct labor activities, the tribal enterprise farm

4 Backgrounding feedlots, hog production, and beef cows are budgeted as alternatives for individual farms but only backgrounding feedlots entered the optimum programming solution.

employs a considerable number of individuals in management and supervising positions. The annual payroll to managers and supervisors on the enterprise farm is expected to amount to nearly $2.5 million when the Project is fully developed.

Net Income and Repayment Ability - 320-Acre Farms

Income as a return to the owners of the capital resources will be derived from three sources if the Project is developed on the basis of individual 320-acre farms. On the basis of assumptions used in this study there will be income from: 1) the operation of the individual farms, 2) income resulting from custom service activities, and processing, and packing facilities, and 3) rent paid to the Tribe by the individual farmers. It was assumed that the Tribe would charge the individual farmers a land rent charge of $20 per acre. This fee would be used to help defray infrastructure and water delivery system expenses. It was also assumed that the Tribe would provide the money for farm building construction, including the farm home, and hence, would charge a rent of $100 per month on the farmstead. If the Project was developed on the basis of 320-acre farms, many of the custom harvesting and processing activities might be performed by non-tribal businesses. However, to simplify the analysis, it was assumed that the Tribe would form tribal businesses to provide custom farm services such as vegetable and grain harvesting, and operate a fresh vegetable packing facility and a vegetable processing plant. It was also assumed that the Tribe would conduct extension education and training services which would be included as a part of the infrastructure.

Direct Farm Income. Individual farms, on the average, will have negative returns to their farming businesses during the first two years of operation (table 64). High start-up costs and lack of farming experience are expected to be the two major causes of this expected loss. Following the plan of developing approximately 31 new farms of 320 acres each year, it is not until the fourth year that the aggregate of all existing 320-acre farms would earn a profit before interest expenses. Annual return to capital and management for the aggregate of all 320-acre farms is expected to increase from slightly more than one million dollars in the fourth development period to over six million dollars when fully developed. The increase in total annual returns to capital and management is the result of increasing efficiency of the farms and the addition of new farms.

Allowing for an interest charge of seven percent on operating capital and on non-repaid investment capital, the aggregate of the individual farms is expected to show a positive return to management of approximately $942,000 during the fifth year (table 64). Annual returns to management are expected to have increased to slightly more than $3.5 million by the twelfth year. Returns to management may be viewed as a surplus income which would be available for repayment of borrowed capital or family living expense if the labor income was insufficient. Returns to management would be sufficient in the fifth year to begin annual principal repayments on investment capital. However, it is not until the ninth year that sufficient aggregate accumulative returns to management have been generated to offset the combined effects of accumulative losses incurred during the first years of operation and the required principal payments beginning in the fifth year (table 64). It is

Table 64. Estimated net returns to management, interest payment, principal payments, annual net expendable income, and accumulative net expendable income for farming operations by 320-acre farms, Navajo Indian Irrigation Project

Period year[5]	Return to Capital and Management[1]	Capital Investment total[2]	Capital Operating	Capital Total	Annual Interest Payment[3]	Return to Management	Annual Principal Payment[4]	Accumulative Principal Payment	Annual Net Expendable Income	Accumulative Net Expendable Income
	. . . . . thousand dollars									
1	(991)	2,265	1,792	4,057	284	(1,275)			(1,275)	(1,275)
2	(1,191)	4,530	3,377	7,907	553	(1,744)			(1,744)	(3,019)
3	(426)	6,795	5,686	12,481	874	(1,300)			(1,300)	4,319
4	983	9,113	7,561	16,674	1,167	(184)			(184)	(4,503)
5	2,266	11,398	9,309	20,707	1,449	817	113	113	704	(3,799)
6	2,774	13,663	10,995	24,658	1,718	1,056	226	339	830	(2,969)
7	3,238	15,928	12,664	28,592	1,978	1,260	339	678	921	(2,048)
8	3,606	18,266	14,354	32,620	2,236	1,370	456	1,134	914	(1,134)
9	4,427	20,531	15,805	36,336	2,464	1,963	569	1,703	1,394	260
10	4,835	22,796	17,165	39,961	2,678	2,157	682	2,385	1,475	1,735
11	5,129	25,207	18,216	43,423	2,873	2,256	795	3,180	1,461	3,196
12	6,062	25,207	18,217	43,424	2,817	3,245	912	4,092	2,333	5,529

1 Return to capital and management is a total for all 320-acre farms on the developed land.
2 Investment capital is a total for all 320-acre farms on the developed land. It includes all machinery, equipment, sprinkler systems, and livestock facilities owned by individual farmers.
3 Interest is computed at seven-percent annually on the operating capital and on the unpaid investment capital balance.
4 Repayment schedule is based on a 25-year period with the first payment due at the end of the fifth year after the loan was made.
5 The table is based on the assumption that 10,000 acres of newly developed land will be added each year.

expected that the aggregate of the individual farms will have an annual net expendable income of $2.3 million in the twelfth year. Net expendable income is defined as the residual income left for the farm operators after payments for interest and capital debt retirement. This income would be available to retire operating debt, living expenses, or expanding the farm business.

Tribal Income. Net operating profit to the Tribe from custom services, fresh market vegetable packing, vegetable processing, and land and house rent activities are not expected to show a profit until the second year (table 65). Net operating profit (profit before interest expense) is expected to increase from $94,000 in the development period to slightly more than $3.5 million when the Project is fully developed. However, the operating and investment capital requirements for processing facilities, custom services, and infrastructure items are substantial, and thereby necessitate large interest payments in relation to expected net operating profit (table 65). The Tribe, if it chooses to perform these services, is not expected to make a net profit after interest payments until the fourth block of land is developed. Net profit from these activities is expected to increase from $133,000 in the fourth development period to approximately one million dollars after total Project development. It is estimated that it will require 14 years of operation before the Tribe would generate sufficient profit from custom services, vegetable processing, and infrastructure rent to offset early development losses and meet accumulative principal payments to obtain a positive net expendable income (table 65). Hence, it is expected to be nearly one and one-half decades after initial development before the Irrigation Project will generate income which can be expended on off-project tribal activities.

Table 65. Estimated net profit, interest payments, principal payments, annual net expendable income, and accumulated net expendable income to the Navajo Tribe on the basis of 320-acre individual farms, Navajo Indian Irrigation Project

Period	Net Operating Profit[1]	Capital[2]			Annual Interest Payment[3]	Net Profit	Annual Principal Payment[4]	Accumulative Principal Payment	Annual Net Expendable Income	Accumulative Net Expendable Income
		Investment total	Operating	Total						
year[5]	thousand dollars									
Startup	(158)	1,913	158	2,071	145	(303)			(303)	(303)
1	(83)	3,879	684	4,563	319	(402)			(402)	(705)
2	94	5,857	1,459	7,316	512	(418)			(418)	(1,123)
3	636	8,695	3,056	11,751	823	(187)			(187)	(1,310)
4	1,627	12,619	8,730	21,349	1,494	133			133	(1,177)
5	2,343	16,081	13,428	29,509	2,066	277	129[6]	129	148	(1,029)
6	2,551	17,890	13,552	31,442	2,201	350	195	155	195	(834)
7	2,753	19,682	13,676	33,358	2,312	441	290	614	151	(683)
8	2,956	21,469	13,807	35,276	2,426	530	421	1,035	109	(574)
9	3,140	23,206	13,904	37,110	2,525	615	536	1,571	79	(495)
10	3,312	24,858	13,977	38,835	2,608	704	596	2,167	108	(387)
11	3,551	25,163	14,076	39,239	2,595	956	656	2,823	300	(87)
12	3,550	25,193	14,075	39,268	2,551	999	716	3,539	283	280

1 Includes profit from all custom farm services performed, packing and processing facilities, land and house rent minus infrastructure expenses. Assumes the Navajo Tribe will operate the service, supply, and processing industries.

2 Investment capital includes investment in all machinery and equipment used in supplying custom farm services, packing and processing facilities, and infrastructure. Operating capital is the capital necessary to operate all farm enterprises such as custom farm services, packing and processing facilities, and infrastructure on an annual basis.

3 Interest is computed at seven-percent annually on the operating capital and on the unpaid balance of investment capital.

4 Repayment schedule is based on a 30-year period with the first payment due at the end of the fifth year after the loan was made.

5 The table is based on the assumption that 10,000 acres of newly developed land will be added each year.

6 Includes principal on investment capital required during the startup period.

Net Income and Repayment Ability - Enterprise Farm Approach

Income for the tribal enterprise farm reflects the fully integrated form of operation. Annual net operating profit is expected to be negative the first two years for the tribal enterprise farm (table 66). High start-up costs and yields below expectations are the principal causes for the net operating loss. The enterprise is expected to make a net operating profit of over $1.7 million in the third year of operation. Annual net operating profit is expected to further increase each year until reaching $16.2 million when the Project is fully developed. The Project is expected to be fully developed in the twelfth year, and hence, this is an estimate of the long-run net operating profit to the Tribe from the Project developed on the basis of an enterprise farm. It is not until the fourth year that the operation is expected to show a net profit after interest (table 66). Annual net profit after interest increased from slightly over two million dollars during the fourth development period to nearly ten million dollars in the twelfth year. Investment capital borrowed for the development of the Project can be repaid out of net profit. However, since the operation is not expected to show a net profit until the fourth year, it was assumed that it would not be advisable to consider repayment of capital until after the fifth year. Although the operation is expected to make a profit after interest expense in the fourth year, it is not expected to be sufficient to offset accumulated losses from the first three years of operation.

Annual net expendable income, which is net profit less principal repayments in investment capital loans, is expected to increase from $2.045 million during the fourth year up to $7.503 million in the twelfth year (table 66). The income would accrue to the Tribe as owners of the

Table 66. Estimated net profit, interest payments, principal payments, annual net expendable income, and accumulative net expendable income, tribal enterprise farm, Navajo Indian Irrigation Project

Period	Net Operating Profit[1]	Capital[2] Investment total	Capital[2] Operating	Capital[2] Total	Annual Interest Payment[3]	Net Profit	Annual Principal Payment[4]	Accumulative Principal Payment	Annual Net Expendable Income	Accumulative Net Expendable Income
year[5]	thousand dollars									
Startup	(38)	2,010	32	2,042	143	(181)			(181)	(181)
1	(1,029)	5,932	2,337	8,269	579	(1,608)			(1,608)	(1,789)
2	(166)	13,276	5,237	18,513	1,296	(1,462)			(1,462)	(3,251)
3	1,755	18,241	9,909	28,150	1,970	(215)			(215)	(3,466)
4	5,454	26,061	22,641	48,702	3,409	2,045			2,045	(1,421)
5	9,398	36,304	42,760	79,064	5,534	3,864	296[6]	296	3,568	2,147
6	10,333	39,746	43,576	83,322	5,812	4,521	663	959	3,858	6,005
7	11,719	43,268	44,311	87,579	6,063	5,656	911	1,870	4,745	10,750
8	12,774	46,717	44,398	91,115	6,247	6,527	1,302	3,172	5,225	15,975
9	13,529	50,072	44,270	94,342	6,382	7,147	1,814	4,986	5,333	21,308
10	14,263	53,385	44,059	97,444	6,472	7,791	1,986	6,972	5,805	27,113
11	14,965	56,048	43,819	99,867	6,503	8,462	2,162	9,134	6,300	33,413
12	16,207	56,489	43,649	100,138	6,370	9,837	2,334	11,468	7,503	40,916

1 Net operating profit is the profit from all crop, livestock, and processing activities minus infrastructure expenses.
2 Investment capital includes investments on all production, packing, and processing activities, plus infrastructure. Operating capital is computed on an annual basis.
3 Interest is computed at seven-percent annually on operating capital and on the unpaid investment capital balance.
4 Repayment schedule is based on a 25-year period with the first payment due at the end of the fifth year after the loan was made.
5 The table is based on the assumption that 10,000 acres of newly developed land will be added each year.
6 Includes principal on investment capital required during the startup period.

tribal enterprise farm. The income could be used to finance additional farm activities or other development and social programs of the Tribe.

Return on Investment

The Navajo Tribe does not have the capital resources necessary to develop the Irrigation Project. Hence, the Tribe will have to obtain the capital from outside sources. It was assumed that the Tribe would borrow the needed funds. The efficiency of borrowed capital is an important factor in selecting an organizational approach. The efficiency measure used in this study was return on investment capital. The estimated annual return to invested capital for both the individually operated 320-acre farm development approach and the tribal enterprise farm approach is discussed in this section.

Interest at an annual rate of seven percent on the operating capital and investment capital debt balance was included as an expense before calculating net returns. Therefore, the return on investment figures are estimates of the percent return on investment capital above seven percent annually.

320-Acre Farm Approach. The aggregate of direct farming activities for the individual farms is not expected to result in a positive return on investment until the fifth development period (table 67). Return on investment during the fifth development period is expected to be approximately 7.2 percent after an interest charge of seven percent has been included. Return on investment increases with each development period and attains a maximum of 12.87 percent during the twelfth period. Since a seven percent

Table 67. Annual return to capital invested in facilities and equipment for individually operated 320-acre farms and tribal enterprise farm, Navajo Indian Irrigation Project

Number of Acres Developed	320-Acre Farms							Tribal Enterprise Farm		
	Direct farm			Tribal activities[1]						
	Investment	Net return[2]		Investment	Net return[3]		Total	Investment	Net return[3]	
	.thousand dollars.		percent	.thousand dollars.		percent	percent	.thousand dollars.		percent
10,000	2,265	(1,275)	(56.29)	3,879	(402)	(10.36)	(27.29)	5,932	(1,608)	(27.11)
20,000	4,530	(1,744)	(38.50)	5,857	(418)	(7.14)	(20.81)	13,276	(1,462)	(11.01)
30,000	6,795	(1,300)	(19.13)	8,695	(187)	(2.15)	(9.60)	18,241	(215)	(1.18)
40,000	9,133	(184)	(2.01)	12,619	133	1.05	(.23)	26,061	2,045	7.85
50,000	11,398	817	7.17	16,081	277	1.72	3.98	36,304	3,864	10.64
60,000	13,663	1,056	7.73	17,890	350	1.96	4.46	39,746	4,521	11.37
70,000	15,928	1,260	7.91	19,682	441	2.24	4.77	43,268	5,656	13.07
80,000	18,266	1,370	7.50	21,469	530	2.47	4.78	46,717	6,527	13.97
90,000	20,531	1,963	9.56	23,206	615	2.65	5.89	50,072	7,147	14.27
100,000	22,796	2,157	9.46	24,858	704	2.83	6.00	53,385	7,791	14.59
110,630	25,207	2,256	8.95	25,163	956	3.80	6.38	56,048	8,462	15.10
110,630 Fully Developed	25,207	3,245	12.87	25,193	999	3.97	8.42	56,489	9,837	17.41

1 Includes investment required for equipment and facilities utilized in custom service, packing, processing, and infrastructure.

2 Includes return to management and capital. Interest charge of seven percent for total capital was included as an expense before calculating return.

3 Interest charge of seven percent for total capital was included as an expense before calculating return.

interest cost is already included, individual farmers could afford to pay an interest rate above seven percent and still obtain a profit. However, interest rates above 12 percent would not allow much margin for price and cost fluctuations.

Tribal or indirect farm activities realize a return on investment above seven percent by the fourth development period; however, this return is only one percent above seven. The relatively low profitability of these activities as compared to direct farming is evident. The maximum return on investment achieved by the twelfth development period is estimated to amount to approximately four percent. Hence, the Tribe cannot afford to pay any interest rate much higher than seven percent without obtaining additional income. Additional income would have to be in the form of increased rent and service fees, and would thereby lower return to the individual farmers.

Tribal Enterprise Farm Approach. The enterprise farm (including production, processing, and infrastructure activities) is expected to realize return on investment of 7.85 percent by the fourth development period and attain maximum return of 17.4 percent by the twelfth period (table 67). This return is in addition to the seven percent charge for investment capital, which was included as an expense item before net profit was calculated. This is a relatively attractive rate of return and should allow the enterprise farm to obtain commercial credit if budgeted levels of efficiency are obtained.

Return on Investment - Comparisons. The combined return on investment for the direct farm and indirect farm activities for the individual farm development approach shows a positive return on investment of 3.98 percent

by the fifth development period. This compares to a positive return of 10.64 percent by the fifth development period for the enterprise farm. The maximum return on investment of the combined direct and indirect farm activities was 8.42 percent for the 320-acre farm approach and 17.4 percent for the tribal enterprise farm during the twelfth period. The enterprise farm approach requires slightly more investment capital than the individual 320-acre farm approach, but net income earned is more than twice as much and gives a much higher return on investment.

CONCLUSION AND RECOMMENDATIONS

Two alternative organizational structures--the 320-acre individually operated farms and the tribal enterprise farm--under which the 110,630-acre Navajo Indian Irrigation Project could be developed and operated have been described in the previous sections. These organizational structures were evaluated in terms of: 1) potential advantages and disadvantages of organizational arrangements, 2) development capital requirements, 3) employment created, 4) training needs, and 5) income generated. The evaluations were based on the assumptions that 1) all irrigated land on the Project would be productively farmed; 2) individual Navajos could obtain the needed financial resources and be trained to successfully operate a commercial farm; and 3) that the Navajo Tribe can obtain the development capital, and through the use of Agricultural Products Industry Board of Directors can hire competent individuals to efficiently operate a large integrated enterprise farm.

The information developed on capital requirements, employment created, training needs, and income generated for both organizational approaches

was based on the combinations of crop and livestock activities presented in tables 40 and 41.

Organizational Arrangements

Coordination of all Irrigation Project activities for both approaches will be one of the most critical factors influencing the success of the Irrigation Project.

In the case of the 320-acre farm approach, this responsibility will lie primarily in the hands of numerous independent individuals, including farm operators and managers of indirect farm activities such as canning plants and farm supply dealerships. Strong farm supply, processing, and marketing cooperatives would assist the individual farmers in achieving economies of size in off-farm activities and in production-marketing coordination.

Coordination of activities on the enterprise farm approach will be centered in a general management group responsible for all production, processing, purchasing, and marketing activities. This type of arrangement should assist in achieving effective production-marketing coordination.

The successful operation of a commercial, irrigated farm requires a high level of managerial ability. Substantial experience in farming is also most helpful. There are presently few Navajos with substantial commercial farming experience. Hence, there is reason to suspect a substantial percentage of the individual Navajo farmers would not succeed. This would probably result in part of the land producing at a very low level or be

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completely non-producing. This would affect the income of the particular farmers involved and reduce the number of jobs and income generated as a result of direct farm production. The tribal authorities could remove non-productive farmers from the land, but in the past they have been reluctant to do so. However, the information developed in this report was based on the assumption that individual Navajo farmers would succeed.

A tribal enterprise farm is also not without substantial risks. Climatic, insect, disease, and price changes make managing a very large farm a risky venture. Because of the need for effective coordination and supervision, there is a tendency for large farming organizations to become over-burdened with costly management and supervision personnel which not only increase production costs but also slow down the decision making process. There would also be the risk of tribal politics entering into management decisions. If tribal politics were to enter into management decisions and the goal of profit maximization was changed in favor of various social objectives, the tribal enterprise farm could falter. It is difficult to operate a large business in a competitive industry without a clear-cut profit objective.

Although a tribal enterprise farm would encounter many difficulties, it would probably present fewer risks and be a more satisfactory organizational arrangement for developing the Irrigation Project than through individual farms.

As a cadre of Navajos become skilled in irrigated crop farming, it is possible that the individual farms could become an effective organizational

alternative for the direct farm production. Most of the economies of production can be obtained with 1,000- to 2,000-acre units or less, dependent upon the types of crops grown.

Processing, marketing, transportation, and most livestock activities to be reasonably efficient require substantial volume and capital investment which are generally beyond the scope of most individual farms. Hence, a combination of individual farms and tribal production, processing, and marketing enterprises might be a workable, long-run organizational alternative.

Capital Requirements

Financing the Irrigation Project may be a problem because of the substantial investment and operating capital requirements. The Tribe does not have sufficient uncommitted sources of funds to finance the Irrigation Project; hence, it must seek development capital from non-tribal sources.

Development of the Irrigation Project under the enterprise farm approach, with all the crop and livestock activities specified in table 41, will require approximately $56.5 million of investment capital. Development on the basis of 320-acre farms, with the crop and livestock activities specified in table 40, will require slightly more than $50 million. Potential financial backers of this Project will be aware of and consider the success of previous irrigation projects developed under an individual farm approach and their high rate of failure. This information, along with the fact that two previous Navajo enterprises, the Navajo Forest Products Industry and the Navajo Tribal Utility Authority, have been financial successes, may convince financial backers the enterprise approach is more likely to be a safe investment.

However, because of the magnitude of the capital requirements needed for the Project, additional federal assistance appears to be necessary.

Employment Created

A substantial increase in employment opportunities is needed on the Navajo Reservation. Both organizational approaches will create substantial full-time and seasonal employment; however, the enterprise farm approach will create more employment during the low production activity seasons. Peak seasonal employment created is nearly identical for both approaches.

Employment part of the year is better than no employment opportunities, but large fluctuation in employment among seasons does present problems. There are relatively few opportunities for Navajos to find additional employment in the seasons their services would not be needed on the Irrigation Project. The enterprise farm, because of more total annual employment and less variation in employment among seasons, would be the best development approach in relation to employment created.

Problems may arise in obtaining enough seasonal labor to carry out the production activities on the Project lands. Many Navajos may prefer full-time employment elsewhere, if available, and may therefore reject seasonal work; however, there are Navajos who do seasonal labor and depend on it to supplement their income earned from raising sheep and cattle.

Training Needs

Training needs are expected to be similar for the enterprise farm approach and the individual farm approach except for the need to train

individual farmers. To be successful, individual farmers must be competent in the areas of crop production and marketing and also in planning, financial management, and decision making. They must also be self-motivated individuals with a desire to work hard and be willing to assume the risks of an independent businessman.

Training of individuals with no experience in commercial farming or in running an independent business to become successful farm operators presents a challenge. An approach might be to provide classroom and field training in equipment operation, cultural practices, marketing, planning, and financial management for a period of time prior to temporary assignment to manage a farm. After several years, the successful managers would be given permanent assignment. The non-successful managers would be placed in other occupations.

Income Generated

Potential incomes to employees, farm operators, and the Tribe from the Project are very important.

The enterprise farm approach is predicted to generate $9.2 million in annual labor income upon development of the entire Project. This is approximately $2.9 million more than created by development on the basis of individual farms. Less variation in the level of employment throughout the year and in wages paid to managers and supervisors for the tribal enterprise farm account for this difference in labor income. Increases in labor income on the reservation resulting from the Irrigation Project will also generate much needed growth in economy of the reservation and the region.

The enterprise farm also demonstrated a better capacity to repay the investment capital loans. The enterprise farm is predicted to realize a positive net expendable income to the Tribe by the fifth development period, whereas the direct farming activities under the 320-acre farm approach will not show a positive return after interest payments until the ninth development period.

Another important consideration is the total amount of annual net income generated upon completion of the Project. The enterprise approach is predicted to create $35.1 million more net expendable income through the first 12 development periods than the combined direct farm and indirect farm activities under the 320-acre farm approach.

Estimated returns on invested capital indicate the tribal enterprise farm approach will return nine percent more to capital than the combined activities under the 320-acre farm approach.

Since the enterprise farm approach is predicted to be more profitable than the individual farm approach, it has greater ability to repay borrowed capital as well as increase labor income through paying higher wages and investing in new activities.

Recommendations

Listed below are the recommendations made after the completion of this study.

1. Begin developing the Navajo Indian Irrigation Project through the tribal enterprise farm organizational structure. This appears

particularly important in development of the first few blocks of land and until such time as a cadre of trained, experienced Navajo farmers can be developed.

2. Begin development of a strong tribal enterprise farming organization on tribal lands in the Shiprock area. All management organizations make mistakes, particularly in the development stages. A farming organization with key management functioning and gaining several years of experience before developing the first block of land would greatly reduce the risk of failure.
3. Set up a program to encourage more Navajos to seek college degrees in agricultural sciences and business management so that they can provide a reservoir of future management talent.
4. Establish a management internship program for Navajos with several large Arizona and/or California farming companies to prepare a group of experienced Navajos for managerial positions with the tribal enterprise farm.
5. Begin concentrated planning on alternatives for accomplishing the training function. There will be a need for approximately 136 individuals trained in performing various activities by 1975.
6. Begin plans for obtaining the needed development capital, particularly for the first several blocks of land. Particular attention should be given to securing government sources of risk capital.
7. Refine estimates of operating capital requirements by using a more sophisticated technique of cash flow analysis. A system of monthly cash flow projections is needed for more precise planning.

8. Refine estimates on the design and costs of infrastructure.
9. Continue research on additional feasible livestock activities that might be added to the present list. These might include broilers, sheep feeding, and possibly a livestock slaughtering plant. The present livestock activites have shown the ability to create relatively stable, year-round employment in comparison to crop activities. The addition of more livestock activities may assist in reducing the seasonal employment variation on the Irrigation Project.
10. Begin research and planning on farm supply and marketing systems and facilities. These include machinery dealerships, fertilizer and farm supply firms, and trucking firms.
11. Continue research and planning on other crops and processing activities that would be profitable and create additional employment and income opportunities.
12. Obtain income and employment multipliers to measure more accurately the economic impact of the Navajo Indian Irrigation Project on the Navajo Reservation and the Four Corners Region.

The Irrigation Project will require tons of fertilizer, chemicals, and other supplies as well as millions of dollars worth of farm equipment. Questions pertaining to dealerships, leasing, storing, and other alternatives available in handling farm inputs and marketing products need to be answered.

APPENDIX A

Table A. Crop and livestock activities considered as possible production alternatives, Navajo Indian Irrigation Project1

Activity	Included as an Alternative	Eliminated Because Of: Climatic conditions	Production reasons	Economic reasons	Shows Some Potential But Not Included	Specific Reason for Eliminating Activity As a Possible Alternative
FIELD CROPS						
Alfalfa	X					
Barley						
Spring			X	X		Low yields
Winter	X					
Beans-dry	X					
Broomcorn		X		X		Growing season too short and declining production trend
Clovers				X		Considered a second choice to alfalfa
Corn						
Field	X					
Silage	X					
Sweet			X			Poor previous production experience
Irrigated pasture	X					
Lespedeza				X		Second choice to alfalfa
Oats				X		Second choice to barley and wheat
Popcorn				X		Market reasons
Rye				X		Second choice to other pastures and forages
Sorghum						
Grain	X					
Silage				X		Second choice to corn silage
Sugar beets	X					
Wheat						
Spring			X	X		Low yields
Winter	X					
OILSEED CROPS						
Flax				X		Decline in production and relative importance
Peanuts			X	X		Low yields
Safflower		X				Growing season too short
Soybeans	X					
Sunflower				X		Low returns
VEGETABLE CROPS						
Asparagus	X					
Beans						
Lima		X				Too high summer temperatures
Snap	X					
Beets	X					
Broccoli				X		Limited markets and low returns
Brussel sprouts				X		Limited markets and low returns
Cabbage	X					
Cantaloupes			X	X		Low returns and problems producing under sprinkler irrigation system
Carrots	X					
Cauliflower				X		Limited markets
Celery		X				Temperatures are too high
Cucumbers	X					
Eggplant				X		Limited market
Garlic			X			Questionable quality of product
Green peas		X				Too high summer temperatures
Honeydew melons			X	X		Low yields and problems growing under sprinkler
Lettuce		X	X			Poor previous production experience in the area
Onions	X					
Parsnips				X		Limited market
Peppers						
Green	X					
Chile		X	X	X		Lower quality and yields when compared with other areas in New Mexico

Table A. Continued

Activity	Included as an Alternative	Eliminated Because Of: Climatic conditions	Production reasons	Economic reasons	Shows Some Potential But Not Included	Specific Reason for Eliminating Activity As a Possible Alternative
Potatoes	X					
Pumpkins				X		Limited markets
Spinach				X		Low returns
Squash				X		Limited markets
Tomatoes				X		Negative returns
Turnips				X		Limited markets
Watermelons			X	X		Low returns and problems producing under sprinkler irrigation
BERRIES						
Blackberries		X	X			Poor previous production experience in the area
Raspberries		X	X			Poor previous production experience in the area
Strawberries		X	X			Poor previous production experience in the area
SEED CROPS						
Alfalfa	X					
Other					X	
FRUIT TREE NUTS, AND BEVERAGE CROPS						
Apples	X					
Apricots		X				Growing season too short
Cherries		X		X		Growing season too short--require orchard heating
Grapes					X	
Nectarines		X		X		Growing season too short--require orchard heating
Peaches		X	X			Poor previous production experience in the area
Pears					X	
Pecans		X				Growing season too short
Persimmons		X				Not winter hardy
Plums		X		X		Growing season too short--require additional heating
Walnuts		X				Growing season too short
MISCELLANEOUS CROPS						
Cowpeas				X		Declining relative importance
Dillweed				X		Limited market
Hops				X		Lack of adequate markets
Peppermint				X		Limited markets and requires specialized processing equipment
Spearmint				X		Limited markets and requires specialized processing equipment
Indian corn				X		Limited market
LIVESTOCK ACTIVITIES						
Cattle						
Backgrounding feedlot	X					
Cow-calf	X					
Finishing feedlot	X					
Steers	X					
Poultry						
Broilers					X	
Commercial egg	X					
Turkeys					X	
Sheep						
Ewe-lamb					X	
Feedlot					X	
Swine production	X					

1 The symbol X indicates the disposition of the respective activity.

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